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# Building a Semi-Rigid Airship

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## Its design—Manufacturing the gas bag—The use and fabrication of duralumin—Assembling the articulated keel—Assembling the pilot car

WHEN one studies and thinks over the troubles presented in building airships, a very high order of engineering is discovered, not only in the design but in the manufacture. The science involved is an interesting intermixture of civil and mechanical engineering, with, of course, special application of the science of aerodynamics. There is a very close tie-up between the manufacturing and engineering departments and a brief study of the design and objects of the ship is necessary to understand some of the reasons why certain manufacturing processes are done as they are.

Before starting design and based upon assumptions established by The Goodyear Tire & Rubber Co. and the United States Air Services, complete stress analysis of each individual member of the envelope, keel, surfaces, power and pilot cars are made and approved by the engineering division of the United States Air Services and the National Advisory Committee of Aeronautics. Designs are subsequently developed to provide members of sufficient strength to meet these stresses with specified factors of safety.

### First Semi-Rigid Ship Built Here

The particular airship that is now being built by The Goodyear Tire & Rubber Co. is the ninety-sixth airship envelope and the thirty-fourth complete airship. It is the first semi-rigid type to be built in the United States and will be the largest in the world of this type. Its official name is the RS-1, meaning "Reconnaissance Short Range." Its length is 282 ft.; the maximum diameter of the gas bag is 74.6 ft.; and the weight without crew, fuel or supplies is estimated at 29,380 lb. The capacity of the gas bag is 719,500 cu.ft.; the gross lifting ability including crew and supplies is 41,550 lb.; and the net lifting or useful load capacity is estimated at 12,170 lb. Twelve men are required as crew; the average cruising range is 1,000 miles or 15 hours, which can be increased to 1,500 miles or 30 hours by operating with fewer motors at cruising speed.

It is called semi-rigid because the factors of stiffness and distribution of loads are secured by the articulated metal keel which is attached to the lowest element of the envelope along the bottom center. The envelope shape is maintained by the internal pressure of the gas inside the envelope which is attached to the keel by cable suspension curtains and bands. The main stresses and bending forces due to static loading and dynamic force are absorbed in the keel. Fig. 1 shows the design—

1—The gas bag forming the main stream line or cigar shape envelope. At the top there will be seen a sort of scalloped edging. This is a catenary curtain, Fig. 2, from whose apexes extend cables fastened to the apex of

2—the keel. This is the backbone of the whole ship and consists of twenty-seven vertical delta frames tied together longitudinally by columns and articulated at each frame to the adjacent frame as will be shown later. The keel is attached securely to the envelope at the apex and also at the two base angles of each delta frame.

3—The pilot car, being the navigating cabin and living and sleeping quarters of the crew, and the two "power eggs," containing the engines, transmission gearing and propellers.

### The Gas Bag

The material used has a base of a very high grade cotton cloth weighing 2.2 oz. per sq.yd. Three plys are used and in building up the complete fabric it is passed forty times through spreading machines, receiving as many coats of rubber. This makes an additional weight of 6.7 oz. per sq.yd. A thin coating of aluminum compound applied by means of a printer's roll, adds 0.7 oz. and brings the total weight of the material to some 14 oz. per sq.yd., and the thickness to about $\frac{1}{200}$ inch.

The tensile strength of the finished fabric is 90 lb. per linear inch in the warp and about 70 lb. in the fill. The aluminum paint is on the outside and is a preservative against action of light on the rubber. It also prevents superheating of the gas. The material is made into rolls 40 in. wide and from this the finished ship is built by cutting suitable shapes to patterns and assembling them up.

Just as the plating for a steel steam ship is laid out so does one lay out the pieces of a gas bag. The finished

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shape desired is carefully cross-sectioned circumferentially and longitudinally and drawings made of the cone frustum pieces that result. These are converted into cardboard patterns. The pattern is the net size of the frustum and in cutting the fabric allowance is made for a lap seam of ¾ in. The aluminum paint is very carefully buffed off by a hand-operated wire brush to prepare it for the cement. Buffing machines have been tried for this work but found unsatisfactory. The pieces are built circumferentially, each one being laid along a pencil line denoting the lap of the previous one. The pencil line is not followed too closely but is averaged as it is more important to prevent puckering than to follow an arbitrary line. This is a most skillful operation and the pieces are held to an accuracy of about $\frac{1}{64}$ in. The lap is sewn together with a double lock-stitch seam, Fig. 3, the threads and thread holes being impregnated with rubber cement. A bias, rubber-coated, fabric tape is put on the outside of the envelope and to overlapping tapes on the inside, attached with rubber cement, Fig. 4. This is done to insure against leakage of gas. Even a minute hole proves most ex-

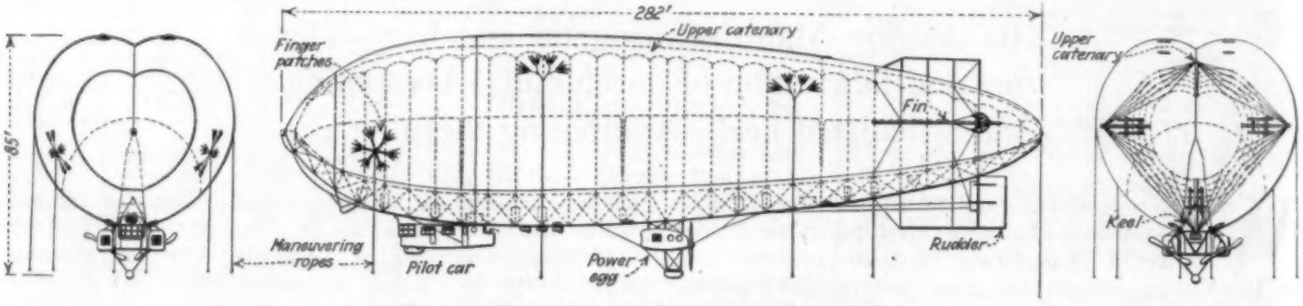
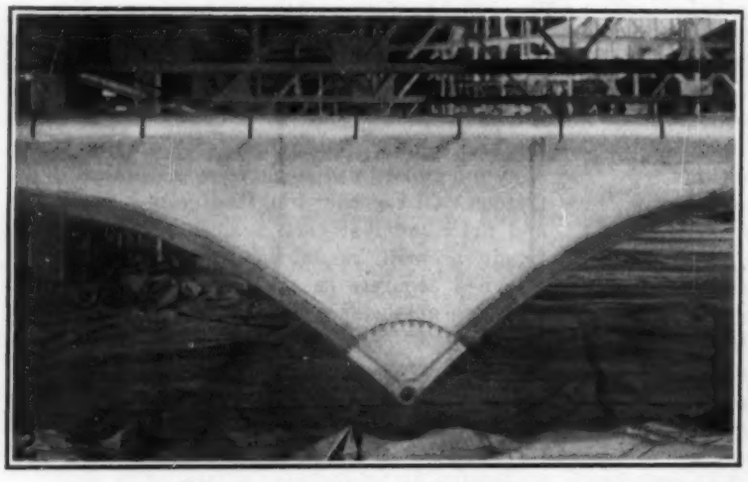



*Fig. 1—Elevations and section of the RS-1*



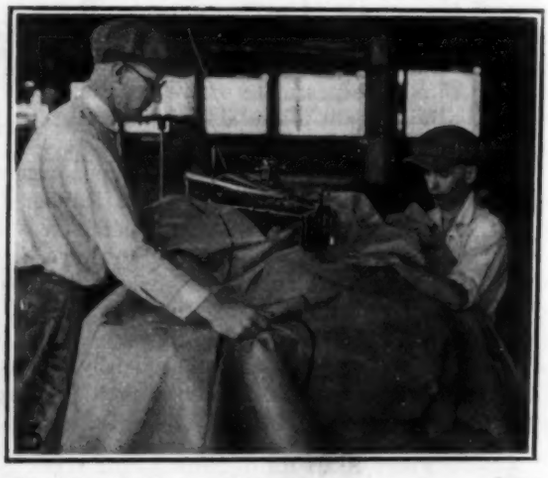


*Fig. 2—A section of the catenary curtain. Fig. 3—Sewing up the gas bag seams*

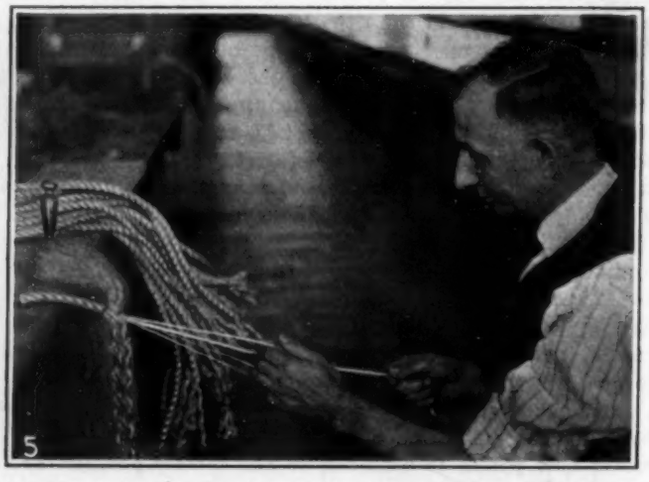



*Fig. 4—Taping the seams of the bag. Fig. 5—Fraying rope ends for "finger patches"*

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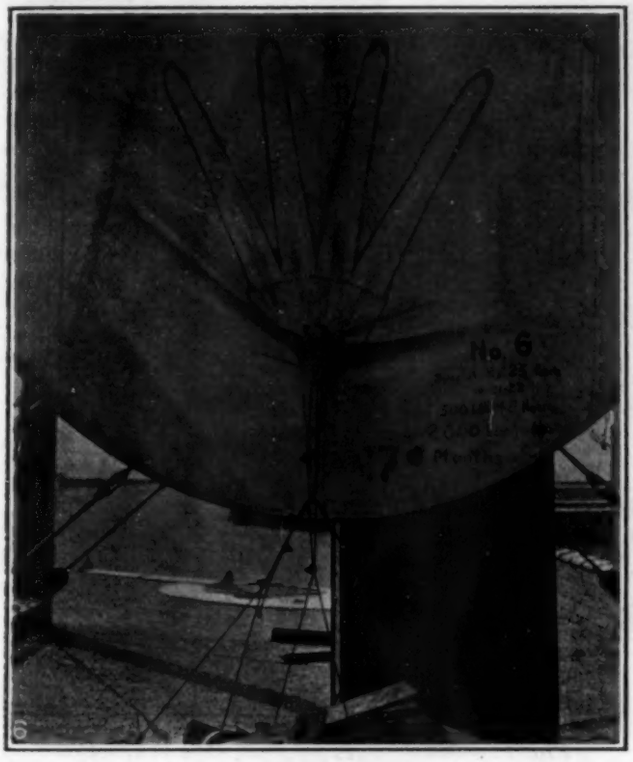

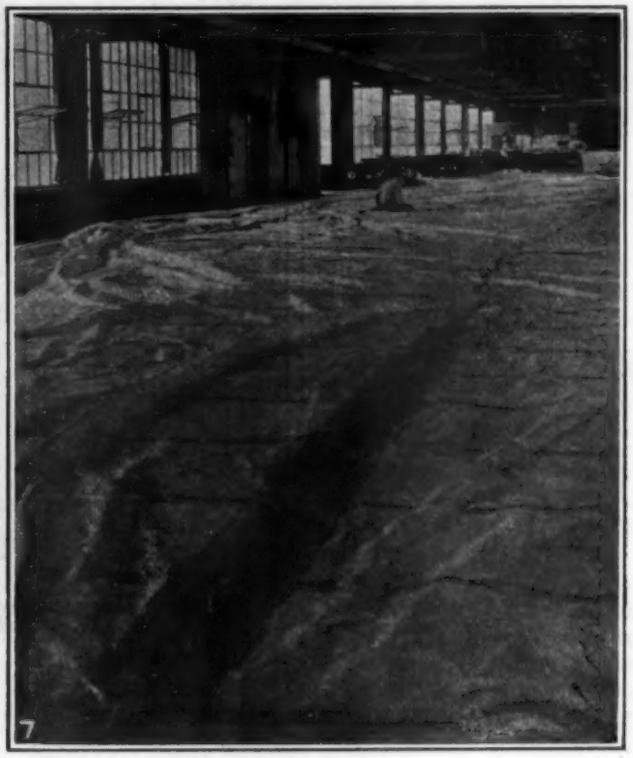

*Fig. 6—A "finger patch" under test.* *Fig. 7—Rip panel on top of envelope*

pensive when one considers the amount of helium (the gas used) that will flow through.

The top of the gas bag is drawn from a true circular form by means of the depression in the longitudinal catenary curtains giving the envelope a heart-shaped cross section. The apex corresponds with each delta frame apex of the keel. There are two similar catenary curtains spaced 10 ft. apart on the lower sides of the bag at the base angle of the keel. The first catenary extends down inside the bag and cables connect its

*Fig. 8—The keel column section*

point with the apexes of the keel. The other catenaries are on the outside and their points coincide with and are lashed to the base angles of the keel. Framing or forming this curve in each case is a wire cable $\frac{3}{8}$ in. in diameter, 125,000 lb. per sq.in. in tensile strength, securely fastened to the main bag by folds of fabric housing it and radiating from it. At intervals averaging 10 ft. there are duralumin eyes set in, to which the cables attach. These eyes will carry a maximum load of 13,000 lb., Fig. 2.

Inside the gas bag are the balloonettes or air compartments which provide space for air and compensate for the loss of gas during flight and to maintain pressure of the gas bag. It is unnecessary to go into the mechanical details except to say that the cables from the top catenary curtain pass through the balloonettes and gas bag to the keel. The escape of the gas from the gas compartment into the balloonettes is prevented by the cables being attached to a flange fitting. This flange fitting clamps to a fabric tube, or inverted "pant leg," which is a part of the balloonette, the flange being clamped down on the cemented fabric in between these clamps. By means of yokes and eyes connecting the flange to the cable, ample freedom of motion is allowed by this "pant leg" between the metal and fabric without interfering with the function of the balloonette.

One interesting piece of work is the attachment of the eyes for the maneuvering ropes and similar attachments. These are called "finger patches" and are made from $\frac{1}{2}$-in. rope frayed out as shown in Fig. 5, the fibers being carefully separated by hand combing and gently stretched so as not to injure them. They are then saturated with rubber solution so that each individual fiber is surrounded by rubber and the fibers are held

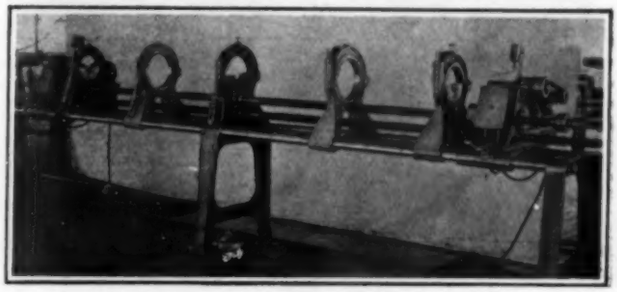

*Fig. 9—Keel column assembly jig*

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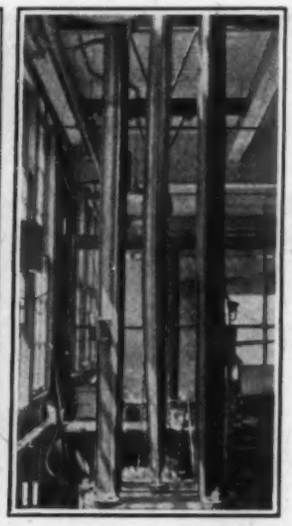


*Fig. 10—Air-operated riveter. Fig. 11—Column under test*

together by this rubber film. The rubber-impregnated rope is cemented to a piece of single-ply fabric and on top is laid another piece similar but wider and then again another piece still wider and larger until the finger is built up as in Fig. 6. The four-finger patch shown weighs about 2 lb. and in tests has supported a load of 2,000 lb. for a period of 18 months. The vertical projected area of the fabric through which the stresses are radiated should have a tensile strength equal to that of the patch.

It will have been noted that great care is taken to taper off the stresses so that there are no concentrated loads and that the total load is distributed over a maximum portion of the bag. The rope used in these patches is Plymouth Yacht rope of a weight of 6.86 lb. per 100 linear fit. and the tensile strength is 2,400 lb. per strand or 9,600 lb. for the group of four.

The other operations which are just mentioned here are the building up and assembling of the balloonettes, the placing of the diaphragm and the valves, both air and gas. This completes the gas bag and gives it a total weight of 8,900 lb. Fig. 7 shows it lying on the assembly floor.

*Fig. 12—The buckled column*

The department in which this work is done is 320 ft. long by 120 ft. wide, divided into two bays, each 60 ft. wide, by a center row of columns. The floor is covered with 8½-oz. per sq.in. cotton duck, to provide a soft covering into which sand and dirt will be depressed instead of being depressed into the balloon fabric. One man has the continuous job of keeping this floor dustless and gritless by means of broom, brush and vacuum cleaner. The men working on the bag wear soft hunter moccasins. The temperature is kept high to reduce the humidity percentage as this interferes with the cementing.

The keel structure is composed of delta frames interconnected with longitudinal columns and is braced and

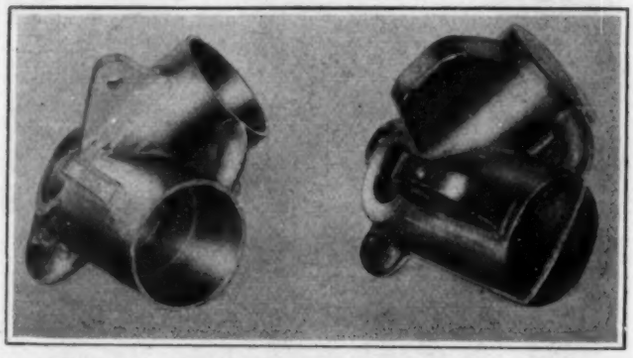

*Fig. 13—Drop-forged keel member connection*

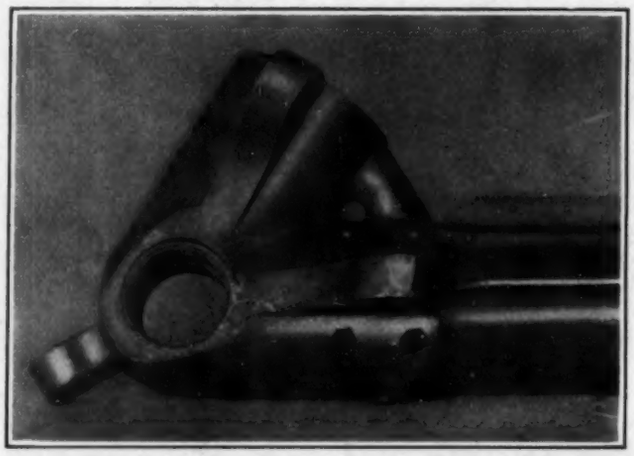

*Fig. 14—Assembly of keel frame joint*

stiffened by streamline cables. The columns are built up from duralumin sheet strips into the general shape as shown in Fig. 8 at *A*. The thickness of the metal varies from 0.05 to 0.150 in., depending upon the place in the structure. This strip is pressed in dies into the shape as shown at *B* on large presses which are used also for the curing of rubber belts, the pressure being applied slowly and gradually raised until a maximum of 800 lb. per sq.in. is reached. The strips are copiously swabbed with 600-W oil to allow of their easy motion in the dies. When one or two pieces only are required the dies can be made of hard wood, but usually they are made of aluminum castings. The pieces are then placed in the assembly jig, Fig. 9, the large circular openings being hinged at the center. The upper half forming a species of clamp is locked with a cam and

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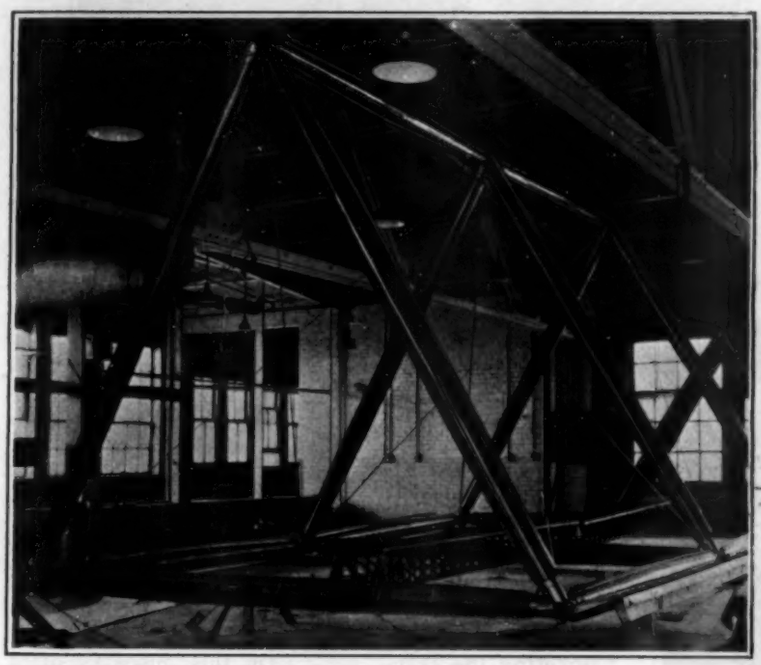

*Fig. 16—Portion of keel assembly*

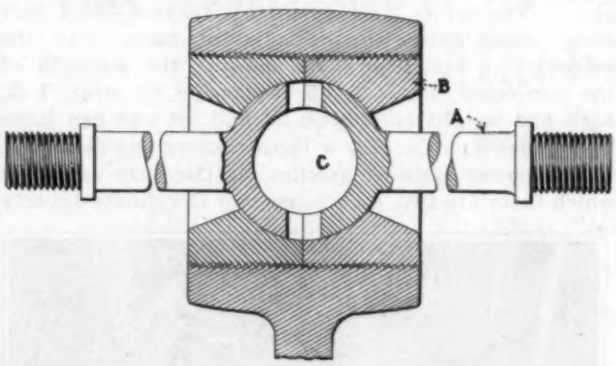


*Fig. 15—Section of articulated keel joint*

toggle device. Prior to doing this the flanges are marked out and center punched by hand. On the fixture a Black & Decker electric drill follows these centers and drills through for the ⅛ in. rivets. First a few holes are drilled at each end and at the center. Into them duralumin rivets are placed and closed with an air-operated riveter of the design developed by the Navy Department, Fig. 10. Finally the whole column is drilled and riveted up. Motor-driven circular saws,

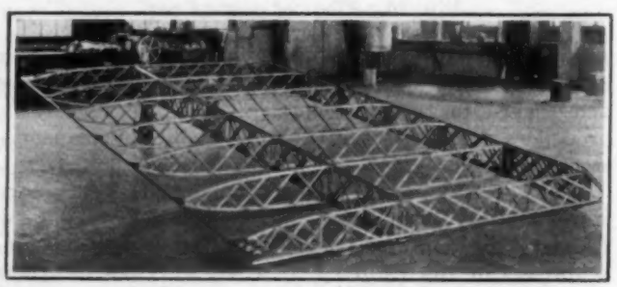

*Fig. 17—Rudder assembly*

one at each end of the jig, are spaced by the lead screw shown which has a right and left hand thread. The column is then cut off to this length. The tapering of the fins as shown is done on a band saw and the edges are smoothed on an abrasive belt. In addition there are four angles riveted along the transverse plane so that the final section is as shown at *C*, Fig. 8.

Similarly the longitudinal members are built up but without the angles. One of these members, 9 ft. 1¼ in. long weighs 47 lb. with fittings and when tested under a combined compression and transverse load, as shown in Fig. 11, withstood a load of 105,000 lb. It buckled as shown in Fig. 12, but interestingly enough after this failure it was fully capable of standing a load of 40,000 lb. The actual load is 25,000 lb. giving a factor of safety of four. Incidentally this factor is used throughout the keel of the ship.

The transverse delta frame members are fastened together at the angles by means of duralumin forged pieces, Fig. 13. The forging weighs as received some 16.8 lb. and when finished less than 5 lb. Only a few of these are required so no special tools and jigs were made. As great accuracy is required a cradle type of jig was made of lead in which the forging is placed and then marked out.

The first operation in machining these forgings is to bore out the hole for the ball sockets and retainers with a standard twist drill, and counterbore with a boring bar using a single fly cutter. This is done on a Cincinnati heavy duty drill press with an ordinary soda oil cutting compound. The tool has a sharp rake

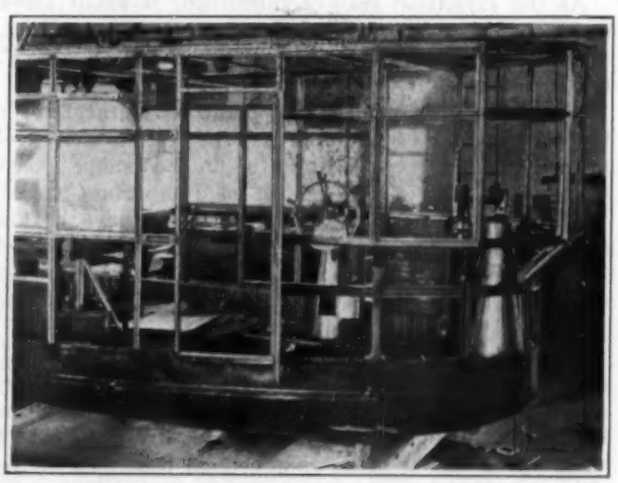

*Fig. 18—Partially completed control car*

or lip. The speeds and feeds are all the machine will give. In other words, the fastest speed is none too fast. The tool goes through exceedingly easily.

The large holes for attaching or holding the column ends are then opened up with a standard 2-in. twist drill and finished with a boring bar with a double-ended cutter. This is done on a Foster No. 3 heavy-duty screw

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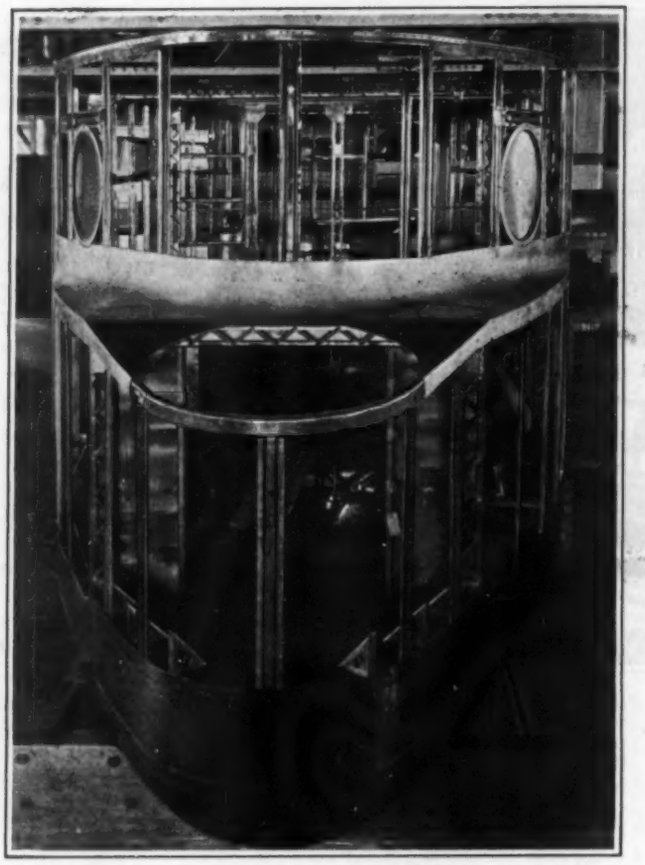


*Fig. 19—Rear end of control car*

machine. The threading is done with a single-point tool and finished off with a ground tap. The lugs are finished with an end mill.

As the expansion rate of duralumin is about three times that of steel trouble was experienced on gaging, so much so that an average temperature of 65 deg. F. has to be worked to, to eliminate variation.

Six of these pieces located at points of vibration over the power cars were made from 5 per cent nickel steel hogged out of forged blocks to the finished shape. Cast steel was deemed inadvisable for such important work.

The ends of the longitudinal columns have a thin steel tubular liner riveted to them. They are pressed into the holes in this piece and the assembly completed with cap screws through to the steel, Fig. 14. Note particularly that no welding is used.

The tapped hole carries an interesting type of ball and socket joint as shown in Fig. 15. *A* and *B* are of nickel steel tempered, *A* screwing to a steel nose of the longitudinal columns and *B* into the threaded part of the forging on the transverse column described above. *C* is a hardened steel bolt 1⅛ in. in diameter. This joint allows of a certain articulation or freedom in the keel structure. As will be seen from Fig. 16, steel wire cables brace up the structure and give it a degree of rigidity. The lattice structure shown in the center of the lower framing is what is known as the "catwalk" and is a path way along the center of the keel. This allows of inspection of the gas and water tanks and other equipment hung from the apex of the keel.

The rudder assembly is shown in Fig. 17. This is built up piece by piece from channel and pressed lattice duralumin parts. When the channels have a sharp curve, they are first of all curved to shape on a three-roll bending machine and are then laid on the floor and set up to wooden blocks to the exact shape. If, however, the curve is gentle, the channels are set up directly on the floor by the wooden blocks. Electric drills drill through this assembly and duralumin rivets are headed over by a hand riveter.

The pilot car, Figs. 18 and 19, is the nerve center of the ship, in which are housed the controls to the engine room, the rudder and the elevating plane, and the gas, ballast and air valves. Here also are the navigating instruments such as the compass, the altimeters and the air speed indicators. Here the crew of twelve live, work and rest during the flight.

Aluminum alloy or duralumin are the leading materials used for the structure. First the main members or bulkheads are built up as described for the rudder. These are shown in Fig. 20. They are then placed upside down on the assembly floor and to facilitate assembly are backed up in position with wooden blocks and the gussets are drilled and riveted in place, thus completing the frame work. On this, piece by piece, sheets of duralumin are placed and pressed by hand into the shape required, then drilled and riveted into place. The car is built up in this fashion—each part being assembled with the adjacent parts until the structure is completed. As showing the strength of the completed car, it is 35 ft. long, 8 ft. wide, 7 ft. high and weighs only 1,930 lb. and yet one can jump up and down on the floor without causing any deflection.

The power eggs or nacelles, as they are called, of which there are two, each house two 12-cylinder Liberty

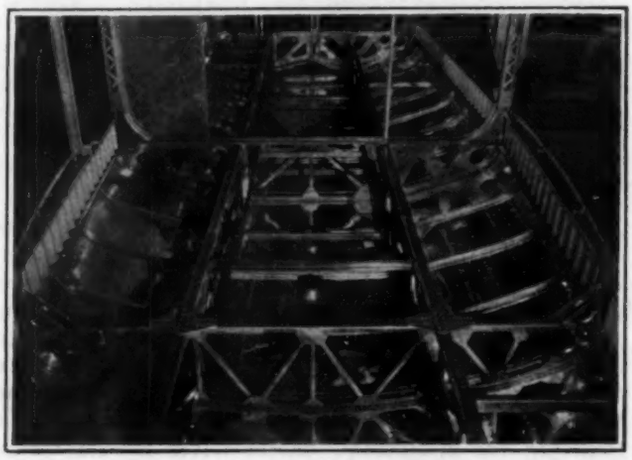
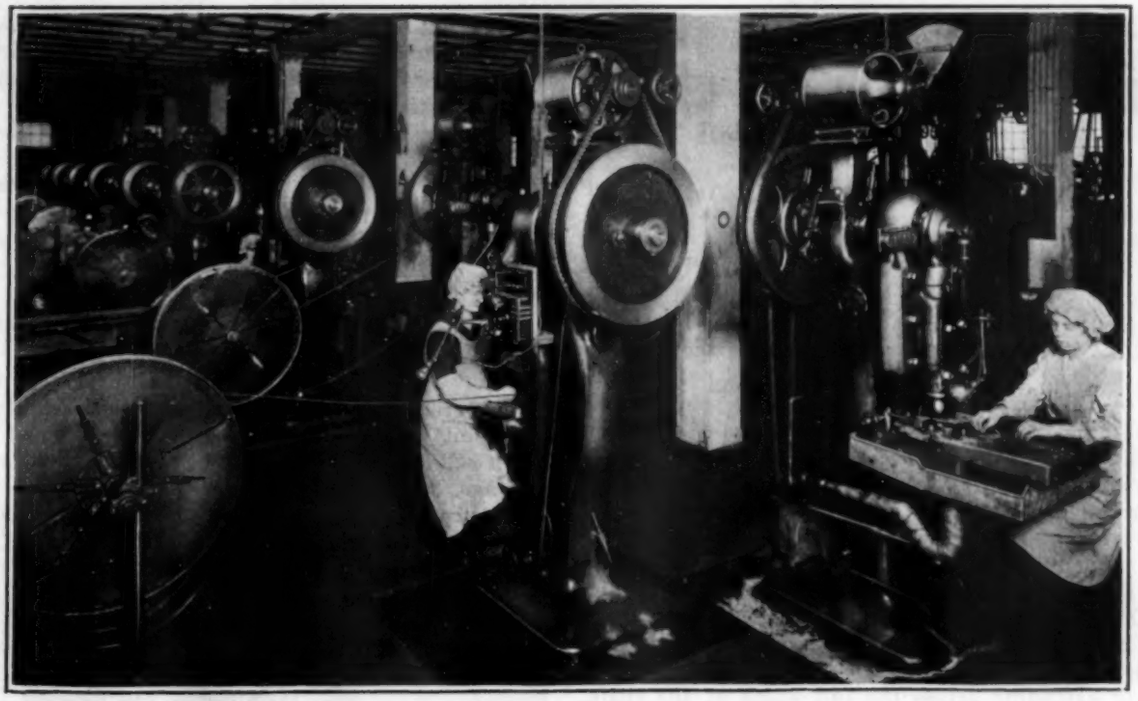


*Fig. 20—Floor of control car*

engines held down to develop 300 hp. each. Two engines drive into one transmission fitted with reversing gears and thence to the propellers. There are two 18-ft. propellers for the airship. Incidentally the transmission transmits 600 hp. and weighs only 395 pounds.

Special thanks are due the members of the Factory Aeronautical Department of The Goodyear Tire & Rubber Company and the Engineering Division representatives of the United States Air Services for their fine co-operation in preparing this article.



# The Application of Silent Chain Drive to Machine Tools

**By Charles R. Weiss**
Chief Engineer, Ewart Plant, Link-Belt Company

## Development and characteristics of the bushed silent chain—Advantages of silent chain drive—Applications of silent chain to machine tools — Principles of automatic chain tightener

POSITIVE action is one of the first requirements of the modern machine tool. The development of cutting tools that make it possible to take heavy cuts, the necessity for keeping the percentage of scrap down to the lowest possible margin, automatic features that are successful only because of the fact that the various parts of the machine will operate positively at the right instant and in proper conjunction with the other parts, the necessity for economy by the elimination of power loss—all these are responsible for the creation of a demand for positive driving mechanism. It is generally conceded that belting is inefficient on short drives, due to lack of traction and the resultant necessity for extreme tightness of the belt, which tends to spring the shafts and is therefore detrimental to the bearings. These undesirable features have been eliminated and positive action has been obtained through the use of gears, which are admirable for close drives. When the driving mechanism begins to be separated, however, the practicability of using gears begins to be doubtful and when the centers are a few feet apart, the use of gears becomes too impractical to be considered. The cost of manufacturing large gears, the noise that is everpresent with the operation of large gears at a high rate of speed, the large amount of space required for the gears—these are features that are better eliminated, if it can be accomplished. And it has been accomplished by the use of silent chain.

Silent chain was developed to eliminate the disadvantages and combine the advantages of both leather belting and gearing. A silent chain drive will transmit to the driven shaft over 98 per cent of the power delivered to it from the driver and will sustain this percentage of efficiency; there is no loss of power through slippage, nor is there any backlash or chatter. It is true that there is a slight amount of wear and a corresponding amount of stretch; where metal engages metal there is bound to be wear and in the case of a slender link engaging with a pin, quite obviously continuous operation over a period of time would result in not only decreasing the pin diameter, but would also enlarge the diameter of the hole. This tendency is clearly illustrated in Fig. 1, which is a reproduction of the old and now obsolete English type of silent chain. It will be seen from the illustration that the hole wore, or enlarged, in the direction of the pull.

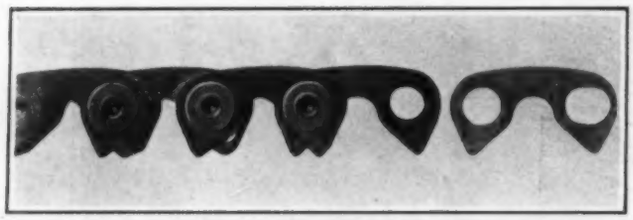


*Fig. 1—English type (obsolete) of silent chain*

which allowed the chain to stretch, increasing the pitch and rendering repair almost impossible. New pins would not take up the wear and, because of the elliptical form of the worn hole, oversize pins could not be used. This tendency was reduced to quite an extent by the use of high carbon steel links and by case-hardening both links and pins, but the difficulty was not entirely eliminated.

A great step toward the general success and universal application of the silent chain followed the invention by Mr. James M. Dodge (at that time president of the Link-Belt Engineering Co.) of the bushed silent chain. Mr Dodge developed a system of using segmental bushings, or liners, illustrated in Fig. 2. By this means he succeeded in giving to each set of opposing links a bearing extending across the full width of the chain, and with both pin and bushings hardened and the avenues of lubrication opened up by the peculiar construction of the joint, the difficulties standing in the way of the rapid expansion of the silent chain business were cleared away. Not only did the development and adoption of the split bushings eliminate wear on the link holes and put the strain and wear of operation on the pin and bushings, but it made maintenance comparatively easy and highly practicable. Through the employment of segmental bushings the holes are shaped to key the bushings in place, which prevents rotation of the bushings due to the action of the pin at periods of engagement and disengagement of the chain with the sprockets.

As the segmental bushings are equal to the chain width, the force exerted on the joints is distributed over the entire width, which results in a reduction of the unit bearing pressure in each joint. The following example more completely illustrates the advantage of the full-width segmental bushings:

1 in. pitch $\times$ 4 in. width $\times$ 0.250 in. pin dia.

Projected bearing area each joint =

$0.250 \times 4$ in. $= 1$ sq.in.

At 1,000 ft. per min. chain speed a

$1 \times 4$-in. chain transmits 22.5 hp.

Thus: $\dfrac{22.5 \text{ hp.} \times 33{,}000}{1{,}000} = 742.5$ lb.

pull in chain load.

Force on joint therefore equals

742.5 lb. per sq.in.

Without the full-width bushing the force exerted on each joint would be doubled, which would equal 1,485 lb. per sq.in. In a silent chain equipped with segmental bushings, such as the Link-Belt silent chain, the joint wear is confined largely to the contacting surfaces between the pin and split bushings, both of which are hardened. Thus, when wear occurs, the original pitch and efficiency of the entire chain is easily restored by the replacement of the worn members with new pins and bushings of standard size.

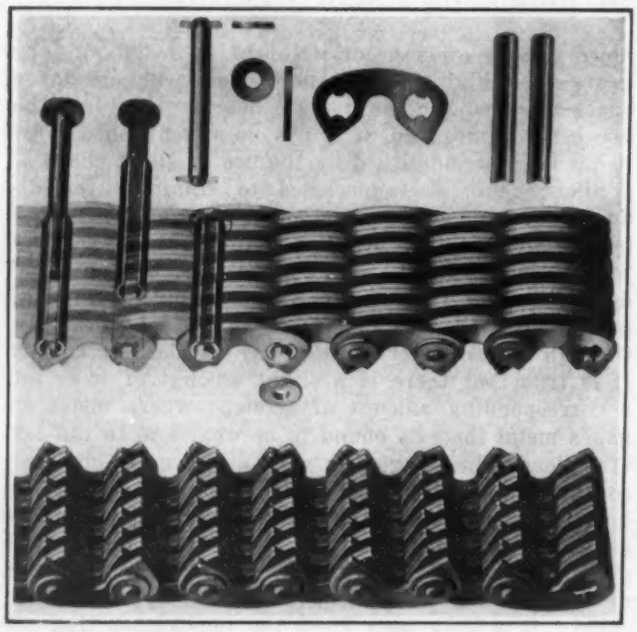


*Fig. 2—Link-Belt bushed silent chain*

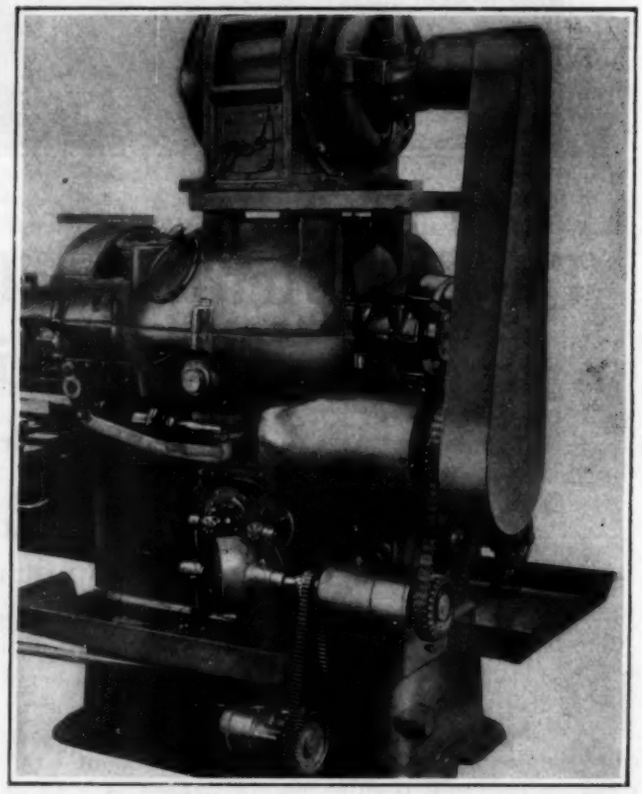


*Fig. 3—Uses of silent chain on Libby lathe*

That the features enumerated above make the silent chain an ideal means of transmitting power in connection with the use of machine tools is evidenced by the number of machine tool manufacturers that have adopted it. The illustration Fig. 3 shows how the Link-Belt silent chain is adapted to the Libby lathe. One chain, which is enclosed in the casing, transmits power from the motor to the main gear shaft, a second one is used to drive the rapid traverse, and the third drives the oil-pump. If the power from the motor were transmitted through a belt, the belt would have to be

very tight and the bearings on both shafts would wear sooner than is the case with the use of the silent chain. Before the silent chain was applied to the rapid traverse, the machine operator complained that the belt slipped when power was applied, a complaint that has been eliminated with the application of the chain. And everyone knows the tendency of the belt to slip off the pump pulley just when the lubricant is most needed.

The machine shown in Fig. 4 is one on which a belt was used with disastrous results, and to which a silent chain has been applied as shown. The machine is a Wickes Bros. lathe, in use in a large automobile plant and is one of a number of machines that are used for turning crankshafts. One of the shafts can be seen in the machine. The old method of driving the machine was by pulley and belt, using a small tightener attached to the motor, with a tension rod for tightening the belt. It was necessary to keep the tightener so tight that an excessive friction load was put upon

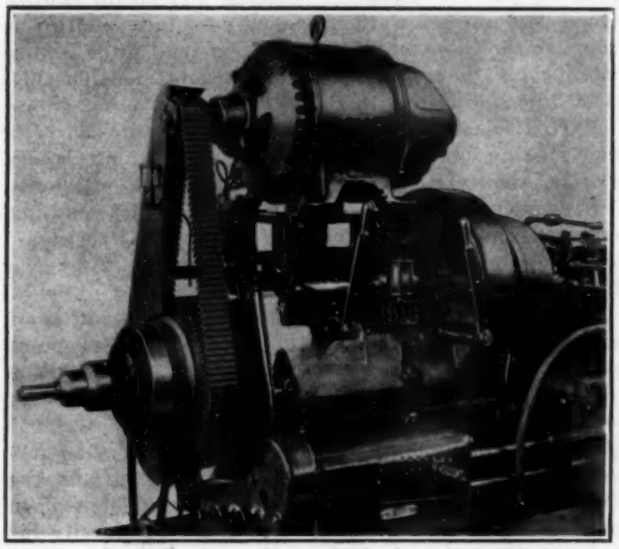


*Fig. 4—The chain drive helps in facing crankshafts*

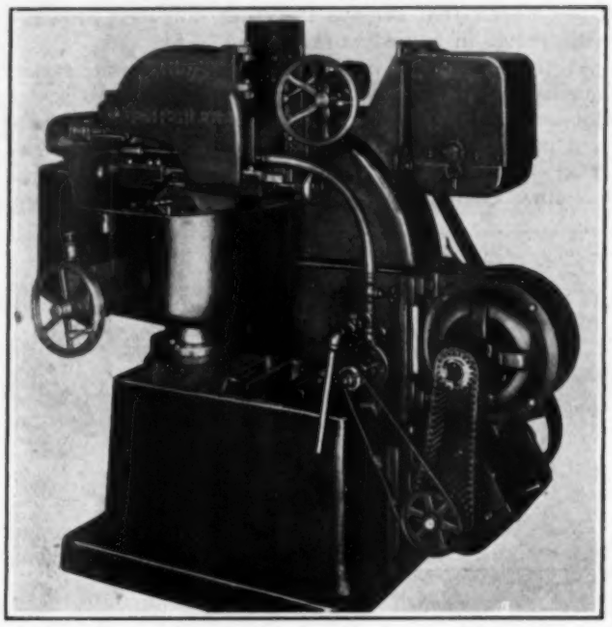
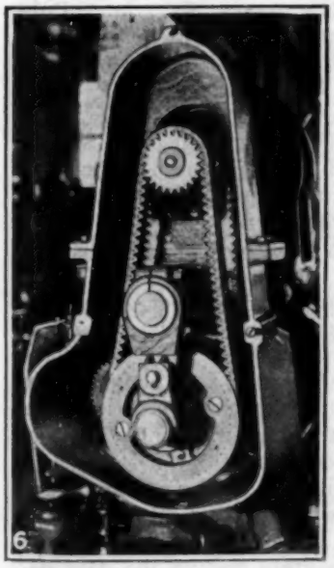


*Fig. 5—Positive action is necessary for centerless grinding*

the bearings, with the result that when a heavy cut was taken, the belt would slip and burn and a jerky motion would be imparted to the main spindle. The jerk frequently broke the high speed cutting tools and became a serious matter. A Link-Belt silent chain drive was applied and the troubles were over. The cut is steady and a heavy intermittent cut can be taken with the use of less actual horsepower than was required with the belt drive. The short drive involved, together with the necessity for smooth, uniform and positive action makes the silent chain ideal for use on such a machine as the Detroit centerless grinder, shown in Fig. 5. The machine is used for grinding cylindrical parts and handles everything from pins that are less than $\frac{1}{8}$ in. in dia. to Ford brakeshoes, which are 8 in. in dia. As the work is revolved by the action



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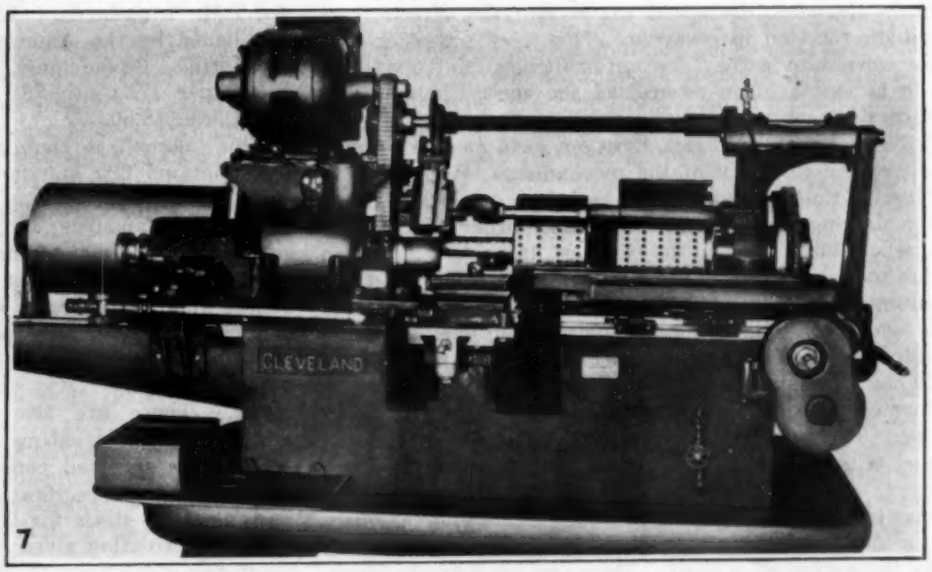


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*Fig. 6—Silent chain driving a Gridley automatic screw machine. Fig. 7—The chain drive is a necessity on quick-action reversing mechanism*

of the wheels that remove the stock, any belt slippage would result in ruined work.

At the beginning of this article is an illustration showing how silent chains have been applied to power presses. The presses are used to punch small parts from metal strips wound on reels, as shown, and the action is very nearly continuous. The records show that since chain drives were applied, not only has the

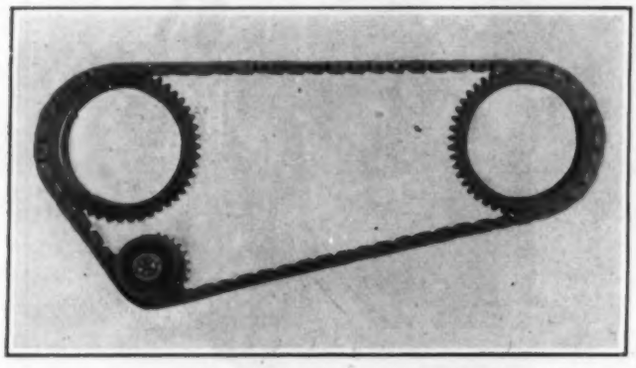


*Fig. 8—Link-Belt Automatic Take-up Idler*

running action of the presses been smoother with less time lost for repairs, but the production has increased considerably.

That the silent chain actually reduces the amount of power required is evidenced by an experience with Gridley automatic screw machines, one of which is shown in Fig. 6. A 7½-hp. motor was formerly employed, driving the machine spindle through two sets of gears and a belt, which it is estimated must have taken at least 30 per cent of the power delivered to the motor. After the chain had been applied, it was found possible to reduce the motor capacity to five horsepower.

All motor-driven Cleveland automatic shaft machines are equipped with Link-Belt silent chain, as shown in Fig. 7. (Guards are used on all machines, but they have been removed in this instance so that the chain can be seen.) Chains are used for driving both the spindle and feed mechanism. In some cases the speed is constant and in others, where an adjustable-speed motor is used, the speed varies and the direction of spindle-rotation is reversed. The speed variation and the reversing action are automatically controlled and the action is often severe, as the speed changes and reversing action are very rapid.

There are mechanisms, however, such as cam actions, where the efficiency of the mechanisms is impaired in direct ratio to the amount of back-lash or slack between the driving and driven shafts. In order to preclude the possibility of even the slightest amount of back-lash due to wear, the Link-Belt Company has developed the automatic take-up idler, shown in Fig. 8. The idler is widely used in connection with front-end drives on automobiles and has been applied to some varieties of machine tools. In principle, the automatic chain tightener consists of a wheel mounted on an eccentric bushing. The bushing is controlled by a coil spring in such a manner that the instant the chain develops any slack, the spring swings the bushing in a direction that immediately tightens the chain again and the bushing and its wheel are held solidly in the new position by the action of a pawl. Thus any tendency to slackness is immediately taken care of and the drive resumes the efficiency of a new chain.

# *Book Reviews*

**Pioneer Inventions and Pioneer Patents.** By Frank Keiper, of the Rochester Patent Bar. Published by the Pioneer Publishing Co., Rochester, N. Y. Second edition, 1924. Cloth; 7¼x11 in.; 152 pages. Price, $3.

This timely treatise on the patent law, which is written in popular form, has been presented in lectures to the engineering students of Purdue University for five years. It is, however, not a textbook, but is intended more especially for the inventor, the engineer, the manufacturer, the law student and the lawyer in general practice who may need a working knowledge of the patent law without making an exhaustive study of it.

The book is divided into two parts. Part I begins with the provisions in the United States Constitution for the issuing of patents, copyrights, etc., goes on to describe how the alphabet, printing and steam engine would be described were they now patentable and gives complete copies of ten of the more famous United States patents, together with the litigation and questions decided in connection with them.

Part II deals with practical questions involved in the making and development of inventions, trade secrets, the relation between inventor and employer, infringements litigation, manufacturing and promoting experiences. Under the chapter "Blue Sky Promises," the book tells of the treatment of inventors by the United States government.

Practical information regarding the preparation of specifications for patents, actual examples of the point under discussion and clear statements should make this book of real value to inventors and those interested in taking out patents. The warning at the end, "The spirit of investigation and the desire to improve and the guarantee of reward have made this age develop, and the absence of these factors that brought development in previous ages to a standstill," suggests the necessity for safeguarding this important factor of our modern civilization.

**A.S.T.M. Standards.** 1,219 pages 6x9 in. Published by the American Society for Testing Materials, Philadelphia, Pa. Price to non-members: Paper $7, Cloth $8. To members: Paper $4.50, Cloth, $5.50.

This volume is a triennial publication of the A.S.T.M., and contains 220 standard specifications, methods of tests, definition of terms and recommended practices.

Of the standards which interest readers of the *American Machinist* we may mention those dealing with steel, wrought iron, cast iron, copper, spelter, lead, nickel, aluminum, brass, bronze and solder. Preservative coatings have also received considerable attention. The standards for steels cover materials for rails, locomotives, ships, rivets, screw stock and plain carbon steels. There are also recommended practices for annealing, heat treating and case hardening. Alloy steels have received considerable attention as shown by the standard specifications for chrome-vanadium for springs, alloy steels for track bolts and other uses.

The information given is very accessible, its arrangement being designed to facilitate finding the data desired. It is a reference volume which all engineers will want to consult.

# Seamless Hollow Metal Balls

**By Tobias Dantzig**
Engineering Department, Hollow Ball Co., Inc., Baltimore, Md.

## Each ball made from a single piece of metal—Cold-processing used throughout manufacture—Standard metals and alloys employed—Especially designed for bearing and valve duties

A BALL is probably as old a device as was known to man. Judging by early records it was used both in warfare and in play from times immemorial. The ancients recognized the ball as one of the four fundamental mechanical elements, the lever, the inclined plane and the wheel being the other three. Yet as a machine element manufacutred on a commercial scale, the metal ball was the last to join the extensive group of standard parts used in the design of modern machinery. The principal cause of this tardy development was the great difficulty in making accurate balls by standard machine tool methods. However, when the advent of mechanical transportation created an active demand for metal balls these manufacturing difficulties were soon overcome. About 1870 the bicycle heralded in our present horseless age. It is only natural that the invention of the ball bearing was almost coincident, for man never realized how wasteful of power and effort friction is until he tried to ride a bicycle. Thus, the bicycle is responsible for the birth of the ball industry and in turn the ball made bicycling the popular sport it became around the year 1880, when steel balls for wheel and paddle bearings made their first appearance in England.

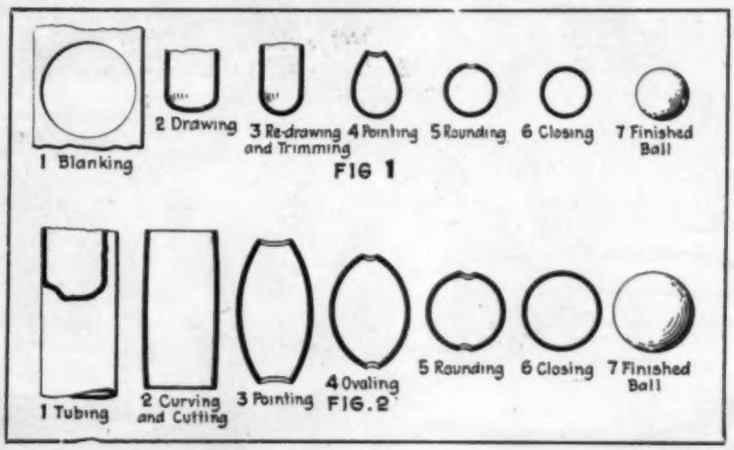
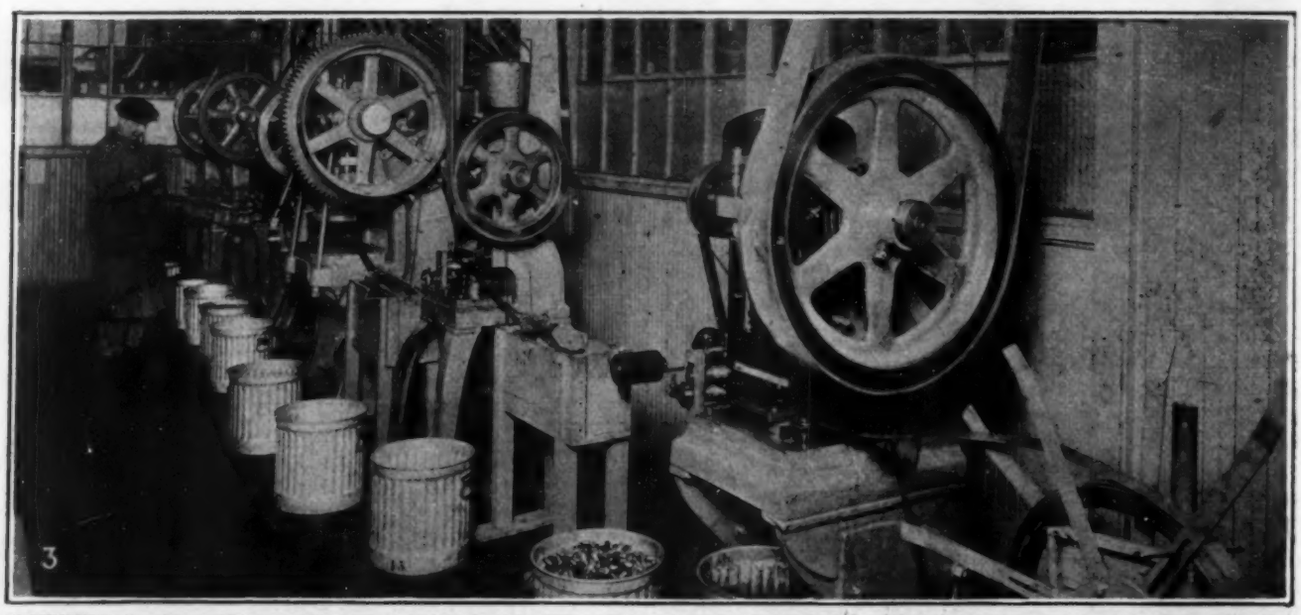


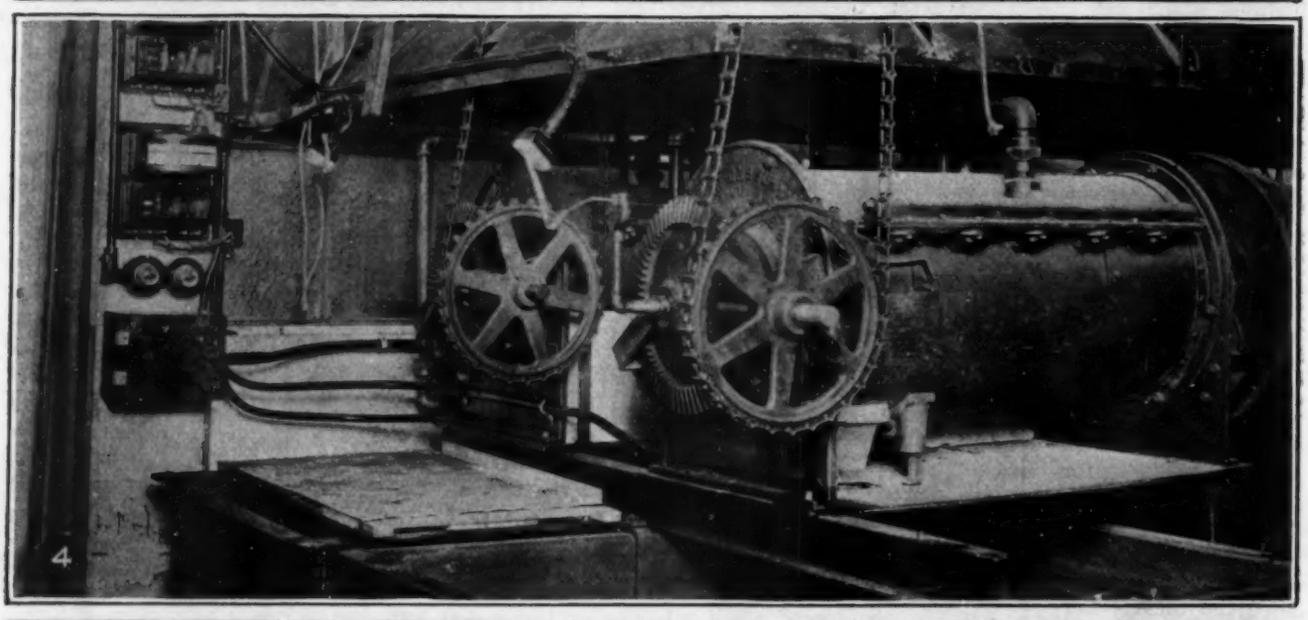

*Fig. 1—Evolution of a "Holbol" from strip. Fig. 2—Evolution of a "Holbol" from tube*

The process by which these first balls were made was very primitive, a foot power lathe being used for turning, while the grinding was done by hand between two cast-iron plates. And the article itself was very crude, an accuracy of 0.003 in. on a ½-in. ball being considered the height of perfection. Yet, from this modest beginning the ball industry has advanced by leaps and bounds until today the annual production runs into billions, the automotive industry alone consuming yearly over 900,000,000 steel balls. Nor is this production limited to steel balls and medium sizes. Balls are now made in all commercial metals and alloys and in diameters ranging from ⅛-in. balls used in typewriters to float balls of 8 in. and above. This marvelous progress, achieved in less than fifty years, can be traced to the development of automotive transportation. Not only has the automobile given the ball industry its commercial impetus, but, indirectly, it is responsible for the very materials of which balls are made, and the very theory on which ball bearing design rests. However, it should not be implied that automotive applications, or even bearing applications, are the only outlet of the ball industry. The ball is finding daily numerous and ever increasing new fields of usefulness in machinery of all descriptions, particularly in valves. A late development in the manufacture of metal balls is the fabricating, out of a single piece of metal, a hollow ball free from seams, joints and plugs and possessing a uniform wall, a homogeneous surface and inherent balance. These balls are manufactured under basic United States and foreign patents controlled by the Hollow Ball Co., Inc., Baltimore, Md., and are marketed under the trade name "Holbol."

There are two ways of making Holbol balls. In the first method, used for balls up to ¾ in. in diameter, the raw material is strip metal. This, properly annealed, first undergoes a series of press operations which convert it into a nearly spherical ball with an opening at one point. The process is illustrated in Fig. 1 which shows the gradual evolution of the blank. Fig. 3 shows a portion of the press department where this evolution takes place.

In the first press operation the stock is blanked and the cup is drawn. The work is done in a double-action press with blanking and compound drawing dies, and equipped with automatic roll feed. The second operation consists of redrawing the blank. The presses doing this work are of the duplex type, also equipped with automatic feeds, a feature of the feeding mechanism being the special adjustment assuring the blank the right position throughout the operation. In the third operation the open ends of the cups are automatically trimmed to length.



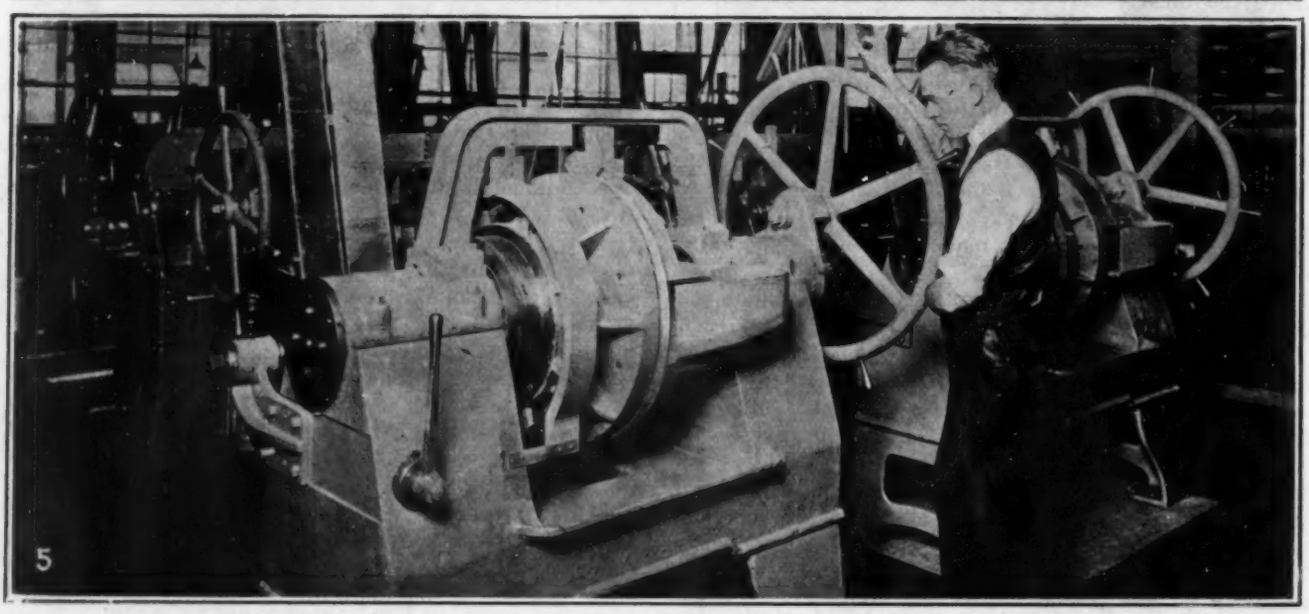




*Fig. 3—Portion of the press department. Fig. 4—Portion of the heat-treating department, showing annealing furnaces with pyrometric control. Fig. 5—The automatic rolling machine*

After the cups have been trimmed to size they are put into a rotary annealing furnace, where the temperature is maintained at a constant level depending on the sizes and metal used. This rotary furnace is illustrated in Fig. 4. The blanks being properly annealed, the cups are first pointed and then rounded into the shape of a ball. The machines used for this operation are automatic presses of the same type as those described, except for the slight difference in the feeding mechanism. At the end of the press operation the blank emerges in the form of a nearly spherical ball with an opening at one point. The problem now is to close this point, of which more later.

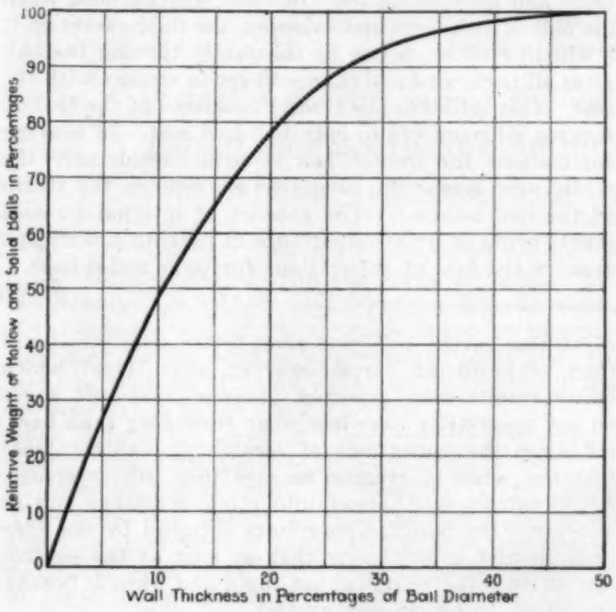



*Fig. 6—Weight of hollow ball in terms of its wall thickness*

For larger balls it has been found more advantageous to use seamless tubing. The evolution of the ball is slightly different so far as the press operations are concerned, and is illustrated in Fig. 2. The distinctive feature of this process is that the tube is first tapered on a radius calculated to compensate for the tendency of the blank to thicken out on the ends during the press operations. From the final press operation the ball emerges uniformly "walled" and nearly spherical with two small openings at opposite points of the diameter.

It is now necessary to complete the ball by closing the apertures left by the press operations and a very ingenious method is used. The balls are placed between the matched grooves of two steel plates, of which one is stationary and the other revolves at high speed. The sections of the grooves are so designed as to permit the ball at the beginning of the operation to have contact with the plates at four points. A hand wheel (see Fig. 5), operating a large screw, permits of drawing the plates together to any desired degree. In this way a tremendous pressure can be gradually applied on the balls within the grooves.

Under the action of the revolving plate the balls roll in a compound motion, which can be described as a combined rolling, spinning and gyrating, and which successively puts every point of the ball in contact with the steel grooves. As the plates are drawn closer together the ball contracts in volume, while the flow of the excess metal accompanied by the strenuous movement of the metal fibers completely closes the apertures and at the same time "uniformizes" the wall of the spherical shell. Furthermore, it must be remembered that as the metal has been handled cold throughout, the strenuous rolling action produces a hard, tough, homogeneous metallic structure, which is characteristic of the cold rolling process.

When the rolling is completed the ball comes out in the shape of a sphere, having an accuracy of about 0.001 in. in sphericity. The ball is then put through a grinding machine where it is brought to any desired degree of accuracy, both in sphericity and diameter; then it is polished, graded, inspected and packed. These phases of production deviate little from the standard methods used in the manufacture of solid steel balls.

In the Holbol process balls of an assigned diameter and metal to practically any wall thickness can be produced; that is to say, the ultimate weight of the ball can be controlled by the process itself.

The accompanying chart, Fig. 6, permits determining the so-called relative weight of the ball in terms of the relative wall thickness. In this diagram the abscissæ represent the wall thicknesses given as percentage of diameter, and the ordinates the weights of a hollow ball in percentages of the weight of a solid ball of the same metal and equal diameter. For example, a ball having a wall thickness of 7 per cent of the ball diameter would have a weight of but 36½ per cent of that of a solid ball of the same diameter.

Selection of the gage of the original material and continuation of the rolling to a desired degree permit of producing balls of a very wide range of weight, from float balls, where lightness is the main requisite, to deep well pump valves, where maximum strength at minimum weight is required.

The standard balls, however, have an average wall thickness of 8 per cent, which according to chart means a reduction in weight of 60 per cent, as compared with

**Comparative Weights for Holbols and Solid Balls in Ounces**

| Ball Dia. in Inches | Brass | | Copper Bronze Monel | | Steel | | Aluminum | |
|---|---|---|---|---|---|---|---|---|
| | Holbol | Solid | Holbol | Solid | Holbol | Solid | Holbol | Solid |
| ¼ | 0.02 | 0.04 | 0.02 | 0.04 | 0.020 | 0.04 | 0.006 | 0.013 |
| 5/16 | 0.04 | 0.08 | 0.04 | 0.08 | 0.035 | 0.07 | 0.011 | 0.023 |
| ⅜ | 0.07 | 0.14 | 0.07 | 0.14 | 0.065 | 0.13 | 0.021 | 0.043 |
| 7/16 | 0.11 | 0.22 | 0.11 | 0.22 | 0.100 | 0 20 | 0.033 | 0.066 |
| ½ | 0.14 | 0.34 | 0.14 | 0.35 | 0.12 | 0.31 | 0.04 | 0.10 |
| 9/16 | 0.20 | 0.49 | 0.20 | 0.50 | 0.18 | 0.45 | 0.06 | 0.15 |
| ⅝ | 0.25 | 0.63 | 0.26 | 0.64 | 0.23 | 0.57 | 0.08 | 0.19 |
| 11/16 | 0.34 | 0.84 | 0.34 | 0.86 | 0.30 | 0.76 | 0.10 | 0.25 |
| ¾ | 0.44 | 1.11 | 0.45 | 1.13 | 0.40 | 1.00 | 0.13 | 0.33 |
| 13/16 | 0.66 | 1.65 | 0.68 | 1.70 | 0.60 | 1.50 | 0.20 | 0.49 |
| ⅞ | 0.77 | 1.93 | 0.80 | 2.00 | 0.70 | 1.75 | 0.23 | 0.58 |
| 15/16 | 0.88 | 2.20 | 0.90 | 2.26 | 0.08 | 2.00 | 0.26 | 0.66 |
| 1 | 1.08 | 2.7 | 1.12 | 2.8 | 1.00 | 2.5 | 0.32 | 0.8 |
| 1¼ | 1.56 | 3.9 | 1.60 | 4.0 | 1.40 | 3.5 | 0.44 | 1.1 |
| 1¼ | 2.1 | 5.3 | 2.2 | 5.4 | 1.9 | 4.8 | 0.6 | 1.5 |
| 1⅜ | 2.8 | 7.0 | 2.85 | 7.1 | 2.5 | 6.3 | 0.8 | 2.1 |
| 1½ | 3.5 | 8.8 | 3.6 | 9.0 | 3.2 | 8.0 | 1.0 | 2.6 |
| 1⅝ | 4.4 | 11.0 | 4.5 | 11.3 | 4.0 | 10.0 | 1.3 | 3.3 |
| 1¾ | 5.7 | 14.3 | 5.9 | 14.7 | 5.2 | 13.0 | 1.7 | 4.3 |
| 1⅞ | 6.8 | 17.1 | 7.0 | 17.5 | 6.2 | 15.5 | 2.0 | 5.1 |
| 2 | 7.1 | 21.3 | 7.3 | 21.8 | 6.4 | 19.3 | 2.1 | 6.3 |
| 2¼ | 9.9 | 29.8 | 10.2 | 30.5 | 9.0 | 27.0 | 2.9 | 8.8 |
| 2½ | 13.6 | 40.8 | 13.9 | 41.8 | 12.3 | 37.0 | 4.0 | 12.1 |
| 2¾ | 18.0 | 54 0 | 18.5 | 55.5 | 16.3 | 49.0 | 5.3 | 16.0 |
| 3 | 23.5 | 70.6 | 24.1 | 72.4 | 21.3 | 64.0 | 7.0 | 21.0 |

solid balls of the same metal and equal diameter. The accompanying table shows comparative weights.

Methods used in the manufacture of Holbols eliminate defective material. First of all, sheet metal and relatively thin tubing are used. As these materials are "cold processed" they are not likely to have surface defects, and such flaws as they may have are readily detected. But even assuming that some defects in the sheeting or the tubing have escaped detection at the hands of the inspector, and the faulty material has been put into process, the defective blanks would be crushed and automatically eliminated during the severe press operations. Each stage in the production is inherently a test of the ultimate strength and reliability of the ball. The method of manufacture also keeps the balls free from internal stresses.

A solid sphere is inherently balanced, provided that the density of the material throughout is uniform. A spherical shell, on the other hand, will be in balance only if it possesses a uniform wall thickness at all points. Inherent balance is achieved through the elimination of all seams, joints, welds or plugs. The processing tends to produce a thoroughly uniform wall. First of all the strip or the tubing is selected for gage accuracy and furthermore by the strenuous rolling action the metal fibers are moved from the points where they are in excess to points of metal deficiency, thus completing the uniformity of the wall thickness.

These features make Holbols particularly adaptable to valve and bearing duties. In valve applications, when the ball is both light and balanced, the fluid exerts on it a whirling effect, which by constantly turning the ball gives all parts an equal chance to get in contact with the seat. This, added to the greater resilience of the Holbol, assures a longer life to both ball and seat. In bearing applications the lighter ball reduces considerably the centrifugal force and, consequently, relieves the strain on the ball retainer. The absence of internal stresses should prove of great importance in bearing service and broaden the field of applications for large metal balls.

## Standard T-Slots

The sub-committee on the Standardization of T-Slots, composed of members of the National Machine Tool Builders and of the American Society of Mechanical Engineers, has made a careful study of the T-Slots now in use. They suggest that there should be 11 widths of slots, to accommodate bolts ¼, 5/16, ⅜, 7/16, ½, ⅝, ¾, ⅞, 1, 1¼ and 1½ in.

It is suggested that the slot be 1/32 in. wider than the bolt diameter for the ¼ and 5/16-in. sizes, and 1/16 in. wider than the bolt diameter for the others. The width and depth of the head space recommended are the same as now made with standard cutters. The depth of throat, or the metal above the bolt head, has not yet been determined.

Three propositions concerning the width of the throat are put out for consideration. One makes the width of the throat equal to the diameter of the bolt. The second allows the clearance indicated above, while the third makes the width of the throat optional between the first and second.

In view of the extent to which German machine tool builders have carried standardization, it is well that a beginning has been made here.

## Smooth Gages Have Long Life

According to the chairman of the last meeting of the Gage Steel Committee at Boston, practical results are just beginning to develop from the work of this committee. He also pointed out that it would be necessary to expedite the work because of the expiration of funds for it at the end of the Bureau's current fiscal year, June 30, 1925.

In the discussion of the work reported, the first question considered was whether or not the gages should be identified by the names of the companies making the service tests. At the suggestion of Dr. Burgess, it was agreed that the company names should be used in the discussions at the meetings and also in the progress reports, if no objection is raised by the interested concerns. Means of accelerating the service testing were considered next.

The chairman then summarized the results with two conclusions drawn from the discussion of the report. First, that carbon tool-steel gives better wear resistance than oil-hardened chrome-bearing steel, from which better results were expected. Second, that soft gages do not necessarily have less wear resistance than hard, but from the indications of scratching, one concludes that the wear is greater because they are scratched. The scratches are spread into other scratches and so accelerate the wear. The results obtained by one concern showed quite clearly that as long as the surface was smooth, the wear was not rapid and when it became scratched, the wear was greater.

The chairman recalled that the lapping wear tests showed greater wear with increased tempering temperature, but that in ordinary lapping practice, soft steel is more difficult to lap than hard steel.

Mr. French commented that the wear test results may depend on the total amount of wear and that the difference in wear between the carbon-tool steel and the chrome-bearing steel is not large.

In speaking of chromium-plated gages, Doctor Gillet pointed out that if the plating can be given good adherence, two problems, permanence and wear resistance, are solved at once. The possibility of reclaiming gages in this way was discussed. The chairman felt that recovery could hardly be economical as most of the expense in gage making is in removing the last ten-thousandth of an inch.

## Study of Quenching Media for Heat Treatment

During the past month work has been in progress at the Bureau of Standards to determine which of the governing factors in aqueous quenching solutions are the predominating ones, so that predictions as to the solution and its concentration giving the desired cooling velocities can be made.

Motion pictures of samples, during actual quenching, on which regular cooling curves are being obtained, have been taken by using a suitable glass quenching tank.

Apparatus is being designed and built for pressure quenching as a means of getting increased rates of cooling for given solutions, and for making emulsions of oil and water without the use of air so that rates of cooling intermediate between oil and water may be obtained.

# Design, Manufacture and Production Control of a Standard Machine

**By Ralph E. Flanders**
Manager, Jones & Lamson Machine Co.

## Attacking overhead as the easiest cost factor to reduce—Segregating the manufacture of different lines—Reducing paper work and handling—Redesign of product and rearrangement of shop

A LITTLE over twelve years ago the author became connected with the Jones & Lamson Machine Co. About that time—or a little earlier—the management of the company began an intensive campaign for the increase of speeds and feeds, improvement in methods of doing work and controlling it, and development of all the other lines of progress which in general come under the head of "scientific management." This work was guided at times by members of the company's own force, and at times by an outside organization of specialists.

The net result of this seven years of effort was decidedly profitable. Speeds and feeds were greatly increased, and the total machining time and total direct labor cost of the product noticeably reduced—and this in the face of considerably increased earnings to the men. All of this is, of course, the expected result of successful work of this kind.

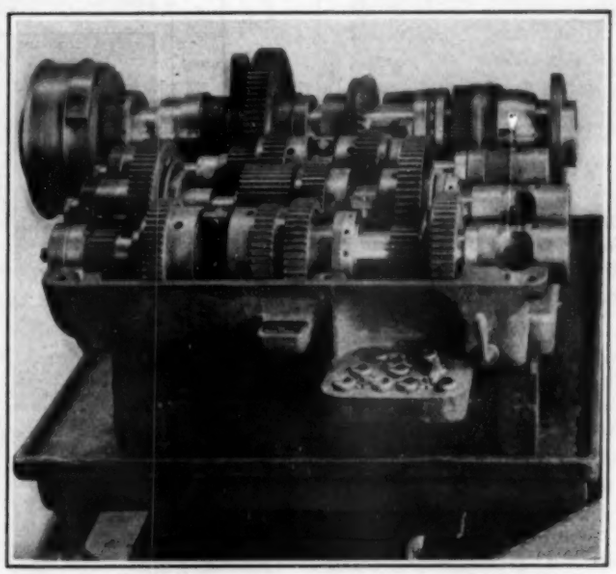


*Fig. 1—Headstock of 3-in. flat turret lathe*

About four or five years ago, however, we lost the first keenness of our interest in direct labor cost and became concerned with the "overhead." With only a moderate increase in output, there has been a considerable increase in the number of foremen—functional and otherwise—and a great increase in the amount of clerical work they were called on to do. In fact, it had become necessary to provide many of them with clerks.

There was also a violent increase in the personnel of the cost and production offices. The attempt to control the whole organization from a central point led also to a flood of written orders and reports, which was evidenced by the multitude, variety, and size of our printing bills.

It was possible, at any time and at any point in the shop, to make a rough estimate as to the percentage of the men in sight who were at that moment actually engaged in the processes of profitable manufacture, and to find that that percentage was quite unsatisfactory.[1]

Finally, the general statistics of the plant showed that the direct labor cost of the product was very small—as had been hoped; it showed the material cost as much higher; but the manufacturing overhead was largest of all—so large that with a moderate selling expense the percentage of profit was somewhat precarious. The percentages were, in fact, such that if the item of direct labor cost had been completely eliminated, there still would not have been any extraordinary profits at the selling prices prevailing.

We are not the only manufacturers, or the first, who have made this interesting discovery. But whenever and wherever made, this discovery is a matter of the highest importance, and should lead to a radically changed treatment of the problem of management.

It was evident that in our case progress toward efficiency in direct labor cost had reached the point where the "law of diminishing returns" became effective, and further effort in that direction would be unprofitable. We therefore transferred our attention to the other elements of cost, and particularly to the largest of them—the manufacturing overhead.

The overhead cost had not grown to its preponderant dimensions suddenly or through carelessness. It was the result of slow accretions of small expenses, each added to take care of some real difficulty in management in what looked, at the time, like the simplest and least expensive way. An examination of the various details did not indicate that they could be successfully improved by individual treatment. A major operation seemed to be "indicated," as the doctors say.

To put it briefly, the major operation decided on consisted in rearranging all the elements of the business so that difficulties were *avoided* rather than *overcome*.

A paper presented at the annual meeting of the American Society of Mechanical Engineers, Dec. 1-4, 1924.

[1] This visual estimate, it may be said, is a quite useful and revealing practice, and every shop manager who has not acquired the habit should contract it at once. It should be made with a view to criticizing the management rather than the workers.

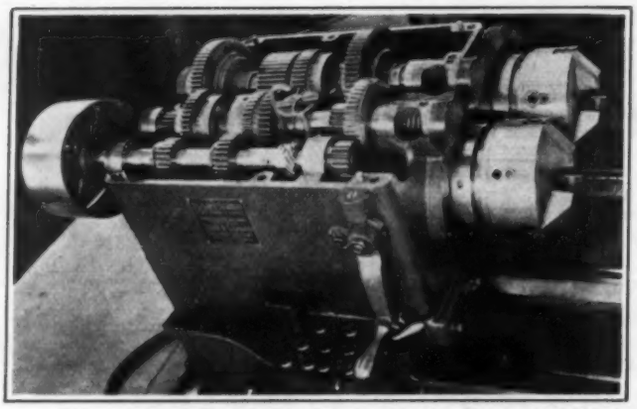


*Fig. 2—Headstock of double-spindle flat turret lathe*

These radical changes are detailed in the following paragraphs.

The oldest and principal product of the company is the Hartness flat turret lathe. Other important products are the Fay automatic lathe and the Hartness automatic opening die. A beginning in segregation had been made some years before in developing the automatic die into a separate business, with its own manufacturing organization and equipment. The Fay automatic was first assembled in a department of its own; it was now in turn provided with a practically complete equipment for making all its parts and given separate quarters.

In the turret-lathe division the work was of two kinds—the manufacture of new machines, and a rather large service business in the supply of replacement parts for the machines (numbering some 15,000) now in the users' hands. Many of these parts were obsolete, being for machines of a design established in 1893. The others were of the then current design, established in 1905.

The final, and significant, act of segregation consisted in separating the service department completely from the turret-lathe production and putting it with all other special work into a division of its own. Here it was united with the manufacture of regular and special equipment for our customers, and the building of tools, fixtures, and special machines for ourselves.

Thus everything irregular, spasmodic, and unpredictable was assigned to this special department, while steady machine production, on a more easily predetermined program, was concentrated in the section devoted to machine building. By working toward regularity and routine we hoped to reach conditions under which a considerable element of the overhead expense would become unnecessary.

Meanwhile there was another element conducing to irregularity which had to be taken care of. While the department could be run under general orders to produce a given number of machines per week, there could

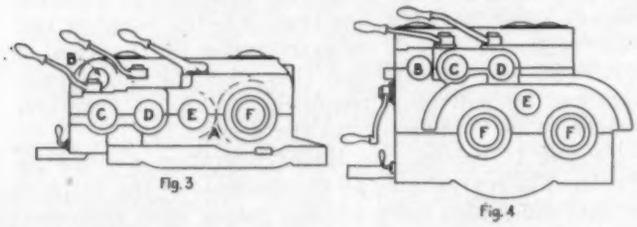



*Fig. 3—End elevation of 3-in. headstock. Fig. 4—End elevation of double-spindle headstock*

be no foreknowledge far in advance as to how many of them should be "2¼-in. machines," how many of them "3-in. machines" and how many of them "double spindles"—these being the shop terms for the three styles in which the turret lathe was built. These machines were designed on the same general plan, and many of the parts in the 2¼-in. and 3-in. machines in-

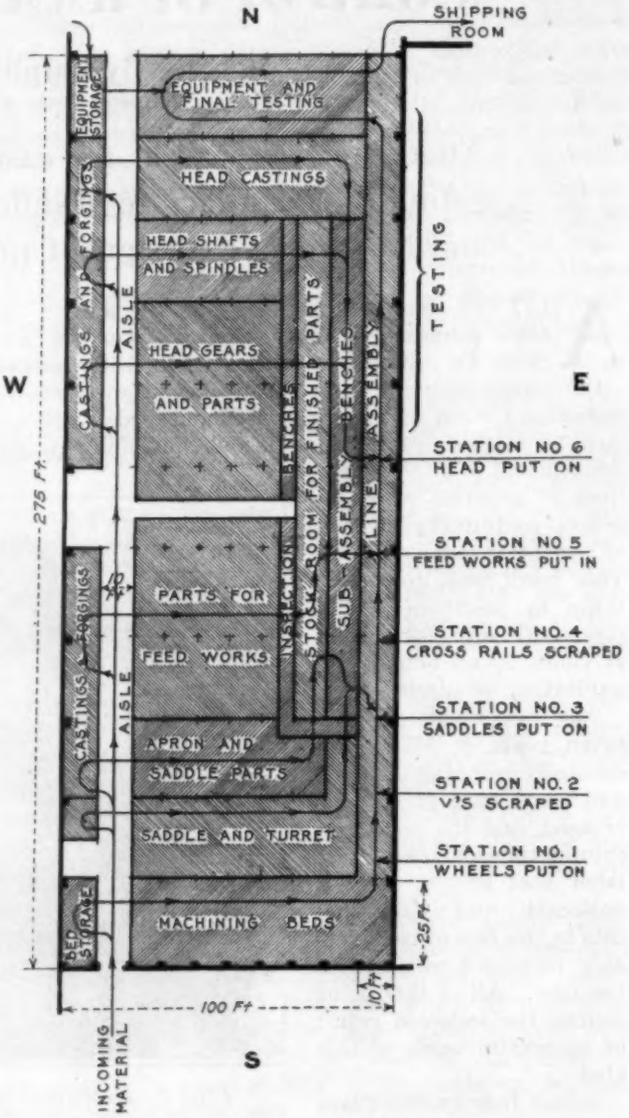



*Fig. 5—General arrangement of turret-lathe shop*

terchanged, but this was not true to any extent of the double-spindle turret lathe.

A redesign of these three types was therefore undertaken to make them as nearly alike as possible, not only in their separate individual parts but also in their unit assemblies. This redesign was so successful that we are now able to assemble three basic sizes (or, with varying equipment, seven types in all) from the same parts with the following variety of major castings:

| | |
|---|---|
| 2 Headstocks | 3 Turrets |
| 2 Spindles | 2 Turret Slides |
| 2 Beds | |

and a few minor parts.

Figures 1 and 2 show respectively the 3-in. and double-spindle headstocks. In the elevations, Figs. 3 and 4, the same shafts are marked by corresponding letters. These shafts, with their complete assemblies

*Fig. 6—Aisle of shop showing bins for raw material*

of gears, clutches, ball bearings, etc., as well as the spindles and their gears and boxes, can be interchanged in either headstock. Except for one or two minor points the man who assembles one of these shafts need not know into what style of machine it is going.

For a 2¼-in. headstock, with its higher spindle speed, the driving-gear ratio at *A* in Fig. 3 is altered, and a spindle with a different nose used. About the only

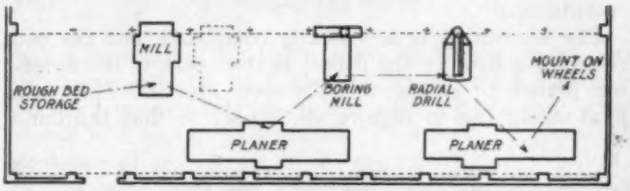



*Fig. 7—Layout of department for bed machinery*

criticism which could be directed against this redesign relates to using the powerful 3-in. drive on this 2¼-in. machine. It is much more powerful than is needed. *But it is cheaper to make it alike and heavier, than lighter and different.*

Besides bringing the design of the machines together, the variety of parts in a given machine was greatly reduced. For instance, the design of the friction

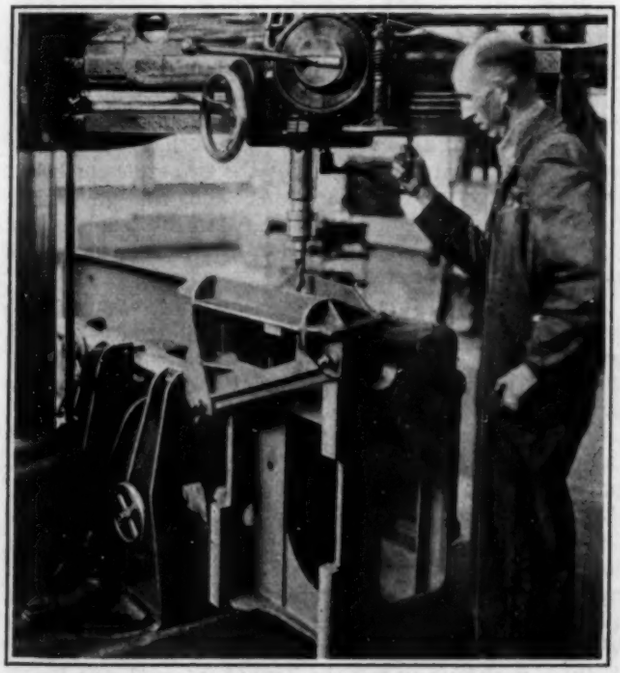


*Fig. 8—Bed at radial drill*

clutches on the different shafts was made the same. These are of the multiple-disk type. On the fast-running shafts with light torque, thicker and fewer hardened disks are used. On the slow-moving shafts with heavy torque, more and thinner ones are employed. All of this work practically cut in half the total number of kinds of parts to be dealt with in making the full line.

The three basic sizes of machine having thus been unified in design, they became for all practical purposes one machine. The workmen scarcely know which size they are working on. They may be put through the assembly in groups of fifteen or twenty each, or mixed together indiscriminately, without making a break in the routine of manufacture.

This unification of the product was in reality a return, in a more developed way, to the first principles followed by Mr. Hartness, who confined the work of the

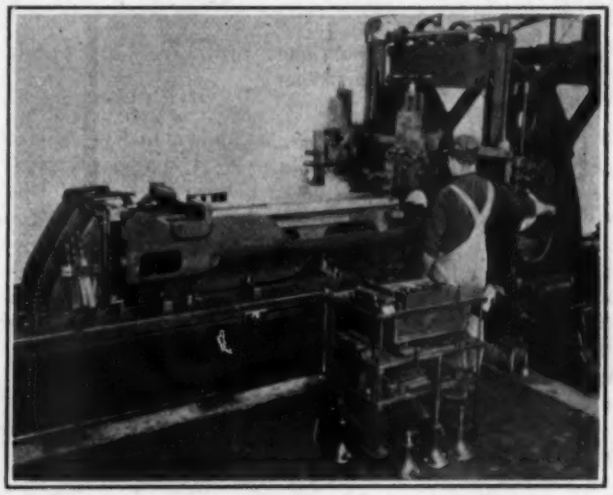


*Fig. 9—Scraping V's of bed in finishing planer*

shop from 1892 to 1905 to one machine and one size of machine. It is needless to say that now, as then, the range of the machines built was carefully determined to cover the largest practicable percentage of the lathe work of the world, in order to give the broadest possible market for our intentionally restricted line.

We now come to the most interesting physical feature of the problem—the arrangement of the shop.

There are two methods of arranging departments—by process and by product. By the former plan all milling is done in a milling department, all drilling in a drilling department, all turning in a lathe department, etc. The argument for this is that by specializing on a given operation the foreman and his assistants become highly skilled in that work, doing it better and more cheaply than if they were concerned with a wide range of operations. The disadvantages lie chiefly in the constant movement of work from department to department, with its consequent slowing up of the work flow, division of responsibility, and difficulty of control.

Arranging the departments by product means that any individual piece stays in a single department until it is completely finished, ready for assembly. Such a department may be arranged to complete all parts of a similar nature, no matter where found in the machine, or all parts of whatever nature belonging to a given assembly unit of the machine. Both arrangements are to be found in automobile manufacture, where departmentalization by product is the rule in the larger and more successful shops.

In this turret-lathe shop it was decided to departmentalize by product, primarily on the basis of the unit assembly, and only secondarily by similarity of parts. This arrangement was expected to prove strongest where the method by process was weakest; and its single disadvantage, lack of specialization by the foreman, was believed (and later found) to be largely illusory.

The space available was 275 ft. long by 100 ft. wide,

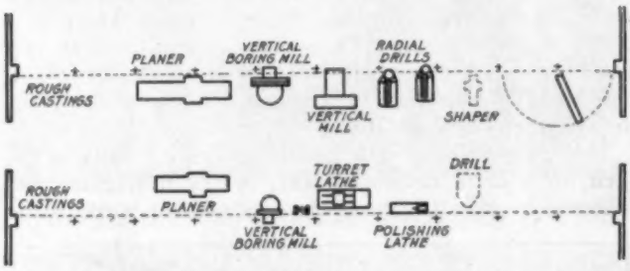



*Fig. 10—Layout of department for turret and saddle machinery*

divided by columns lengthwise, as shown in Fig. 5, into 10-ft. aisles, and crosswise into 25-ft. bays. Experience with this shop leads us to believe that about this width of shop and width of cross-bays are ideal for medium-sized manufacture. The columns should, however, be spaced to give 20-ft. aisles, as has been done in our later construction. The later buildings are also increased in width to 120 ft. Such shops may be built to any length required by the magnitude of the production. The building referred to is of steel-frame, saw tooth-roof construction and fireproof.

The general arrangement is indicated in Fig. 5. The incoming material passes north up a long aisle extending the full length of the shop. In the aisle on the left, next to the west wall, are the bins in which the raw material is stored (Fig. 6). The center of the shop is occupied by the various manufacturing departments which are, in order, reading from south to north:

Bed
Saddle (Turret Slide) and Turret
Apron and Carriage Parts
Feed Works
Head Gears and Parts
Shafts and Spindles for Head
Headstock Main Castings.

After that comes the Equipment and Final Testing of the machines, as will be explained.

In successive aisles toward the east, and running for practically the full length of the manufacturing section,

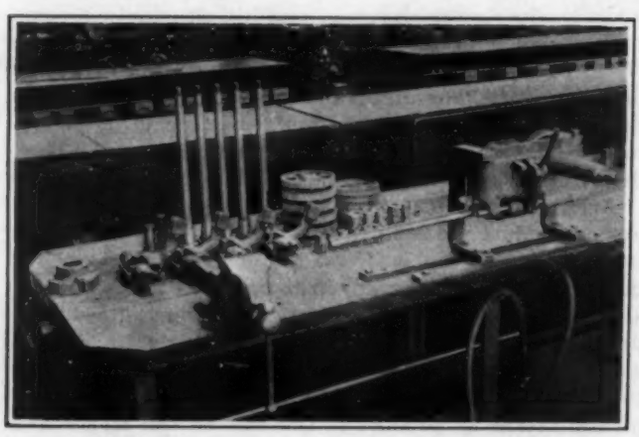


*Fig. 11—Sub-assembly of apron parts*

come the Inspection Benches, Storage of Finished Parts, Sub-Assemblies and Line Assembly. From the Line Assembly the finished machines detour into the bay for Equipment and Final Testing, and out into the Painting and Shipping Room.

The flow of material is thus from the southwest corner north to the appropriate department, thence directly east across the width of the shop to final inspection and storage, thence to sub-assembly and line assembly. The line assembly moves north on the eastern side and out at the northeast.

Let us follow the progress of the bed. The arrangement of the machines for its department is shown in Fig. 7. The castings are stored at the west of the aisle. From there they are taken first to an Ingersol mill, where the pads on the bottom are milled off, after which the bed is turned over and the cross-rails milled. Space for a second mill is left as shown by the dotted lines in Fig. 7. The bed now goes to the roughing planer, and thence to the horizontal boring and milling machine. The next location is the radial drill, Fig. 8. Here the bed is held by the V's or special fixtures, and light sectional jugs, as shown, are used for the drilling operations.

The machining is now nearly completed, and the bed rests for a time on the floor. It then goes to the finishing planer to scrape the V's—see Fig. 9. This is a final machining to remove all "wind" so that the hand

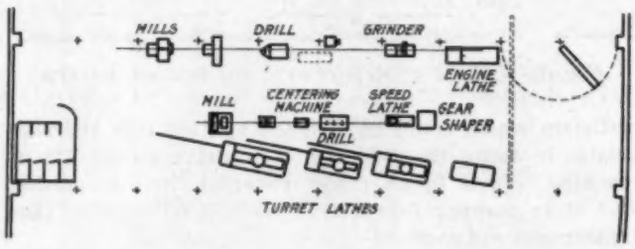



*Fig. 12—Layout of department for machining apron and turret-slide parts*

scraper's job shall be one of finishing the surface rather than of removing material. The bed is now mounted on wheels instead of its regular legs, and is ready to start up the assembly line—of which more later.

The important things to observe are the permanently mounted fixtures (adjustable for the two styles of bed), the simplicity of the operations, and the unvarying routine of the procedure. The department is under the foreman of the line assembly, but as a matter of fact it is practically self-managing.

The "saddles" (turret slides) and turrets, machined in the next department, are also large pieces. The layout is shown in Fig. 10. When completed these parts shift north to the appropriate point in the sub-assembly aisle.

The apron and turret-slide parts in general comprise main castings, gears, shafts and studs, and milled steel parts. Fig. 11 shows a sub-assembly of apron parts. The layout for this department, Fig. 12, shows three lines of tools. The upper or northern line, comprising mills, driller, etc., takes care of the castings and milled steel parts. The lower or southern line, composed of turret lathes, machines the shaft, studs, and gears which, however, pass north at the end through the Fellows gear shaper and the Bryant internal grinder on their way to the inspection bench and the parts storage.

The central line is composed of miscellaneous machines common to the other two.

This arrangement exemplifies the subdivisions of the department on the basis of the character of the parts machined. A similar case is shown in Fig. 10, where the turrets go east along the south side, and the turret

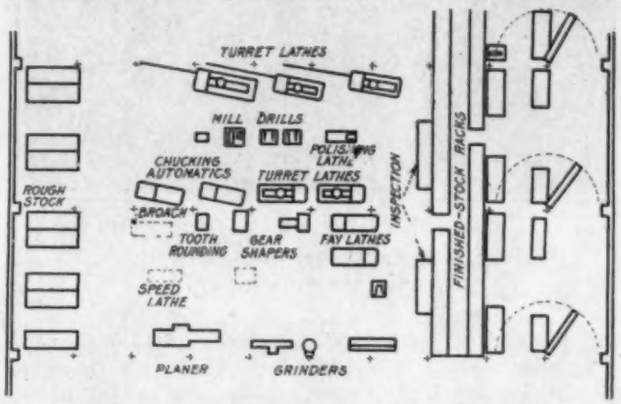



*Fig. 13—Layout of department for machining feed-works parts*

slides east along the north side. In this way the flow of every part can be made to approximate a straightforward progress from west to east, with only occasional and minor divagations. This makes for ease of control and orderliness in the department.

The layout of the department for machining feed works parts is as shown in Fig. 13. Here again we have separate lines of machines for different classes of work, as indicated on the layout. From the machines the work is handed over to the inspection bench and thence to the stock room. From there it goes to the subassembly and line assembly.

The head-gear department is laid out as shown in Fig. 14, and the shaft and spindle department as in Fig. 15. A pair of Fay automatic lathes are kept set up with an adjustable, but standard, equipment for the shafts, as shown in Fig. 16. The succeeding spline millers, drills, and grinders are plainly indicated.

The head-castings department is interesting for its specialized equipment. The bases are planed on the bottom, then caps and bases are milled for the joint. After drilling together, the united headstock goes to a special boring machine, shown in Fig. 17, when all the shaft and spindle holes are rough and finish bored,

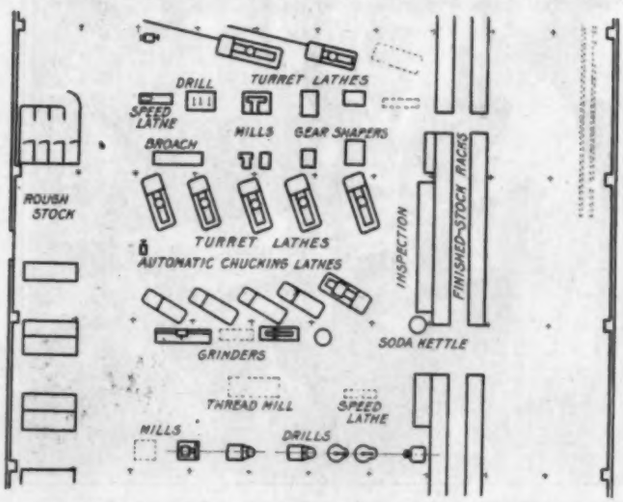



*Fig. 14—Layout of head-gear department*

reamed, faced, and tapped at one setting. The machine for this work costs much less than a standard boring machine and jig for the same purpose, and finishes all the holes at once instead of one at a time. This is an example of the economies possible in continuous production.

The head then goes to the radial drill, etc., for finishing operations, and thence to the sub-assembly, on a trolley beam around the north end of the finished-parts storage.

Let us now return to the assembly line, following the order shown in Fig. 5. The different operations are so divided as to give about equal lengths to each.

At the first station, see Fig. 18, the wheels are put on. At station 2 the V's are scraped. At station 3, the turret slide is put on, scraped to the V's, and the turret rescraped to the slide. At station 4 the cross-rails for the cross-sliding head are scraped, using special devices to bring them at right angles with and parallel to the V's.

At station 5 the oil pump and piping and the feed work are put in. The machine is now in a condition shown in the foreground of Fig. 19. Next the headstock is placed on the machine, as shown in the same illustration, and it is now complete. There are still, however, five stations remaining before reaching the department for equipment and final testing. Advantage is taken of this space to give the machines a final

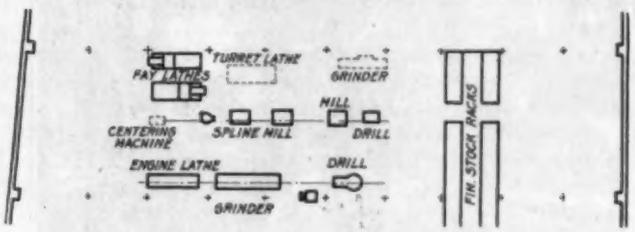



*Fig. 15—Layout of shaft and spindle department*

"run-in," they being belted to the motors shown overhead.

This running-in is opposite to the head assembly and is under the care of that group. Any difficulties or needed adjustments are taken care of here.

There is nothing special to be said about the department for equipment and final testing. The machines are mounted on their legs here, equipped with motors if required, and then with regular or special equipment as may have been ordered. Finally they are put through standard alignment and operative tests.

There are certain departments and operations not included in this layout. Steel storage and cutting-off are taken care of in one department for the whole plant. So are castings, snagging, cleaning, and filling. These come before the parts arrive in the turret-lathe shop. After the machines leave the equipment and testing department they go to a painting, boxing, and shipping room common to all of the products.

Automatic-screw-machine products are taken care of in one department for the whole shop; and so, finally is the hardening and heat treating. This latter operation is the only one making a break in the orderly flow of work through the shop.

With this description of the shop arrangement in mind, we can now return to a discussion of the way in which this arrangement and its accompanying methods of management operate to reduce the overhead.

The orders for parts are routed through this shop in

a predetermined and effective course, but without any machinery of control. The rough- and finished-parts stock rooms are kept supplied with an adequate store of parts to prevent any hold-up in production, but there is no stockkeeper assigned to them; nor does this lack of special supervision result in unbalanced or undesirably large inventories or in unexpected shortages. These desirable features are attained by a "program" scheme of ordering and routing all parts except the main castings.

Each order is nominally of a sufficient size to furnish enough for a two-month's production. An order for a given part is thus placed in the shop every two months, or six times a year. The second period of the year (March and April) is an exact duplicate of January and February. A standard routing of all the parts passing through a given department may thus be laid out, from machine to machine, and duplicated for the next period and the next, and so on for the six periods of the year.

The routing was originally laid out on the basis of full production of five machines per day, on special sheets provided for this work. Fig. 20 shows sample pages from this routing book.

This standard routing is made up on the basis of our previous years experience in speeds and feeds, and is arranged to put the orders through in the minimum

*Fig. 16—Automatic lathes with adjustable equipment for machining parts*

time, with sufficient waits between operations to insure against trouble. All long waits, however, are eliminated, and with them the expensive items of storage space and idle capital for inactive stock. The ideal aimed at has been that of a small, fast-flowing stream of work instead of a large, sluggish one. Further insurance against trouble is offered by reckoning on only about 80 per cent of the theoretical machine capacity. The margin takes care of breakdowns, breaking in new operators, poor stock, etc. There is the additional possibility of running overtime in an emergency.

The original laying out of the schedule is a matter of juggling, judgment, and experience. A successful solution implies a minimum of equipment, a minimum of floor area, a minimum inventory of work in process, a maximum rate of progress of the work, and *a simple and easily comprehended standard of achievement for the department.*

The finished routing schedule gives a starting date, repeated every two months, for each part. These starting dates, with other data, are recorded on a card of standard size. If castings or forgings are required, the date on which they are to be ordered is also given, and on that date the foreman is held responsible for making a requisition on the purchasing department.

*Fig. 17—Special machine for boring and finishing all shaft and spindle holes in headstock at one setting*

Note that a wide range of rates of production is provided for—from 3 to 30 per week. The rate of production is determined by the general management, and the shop takes its information from the corresponding line on the card.

Now there is supposed to be carried in the rough-stock bins a full half-lot of castings or forgings in reserve. The first step of the foreman is to count this reserve stock. If it is below normal for the scheduled production, he adds to the normal order enough to make up the deficit. If it is above normal, he decreases his normal order by this amount.

This half-lot in reserve is insurance against trouble. It takes care of poor castings, delayed deliveries, spoiled work, etc. It is particularly important from the standpoint of starting the orders on time. If only half of a lot has arrived, it is still possible to put the work into the shop by drawing on this reserve. The *sine qua non* of this method of production control is starting on time. Nervous tension, frantic struggling, and despair-

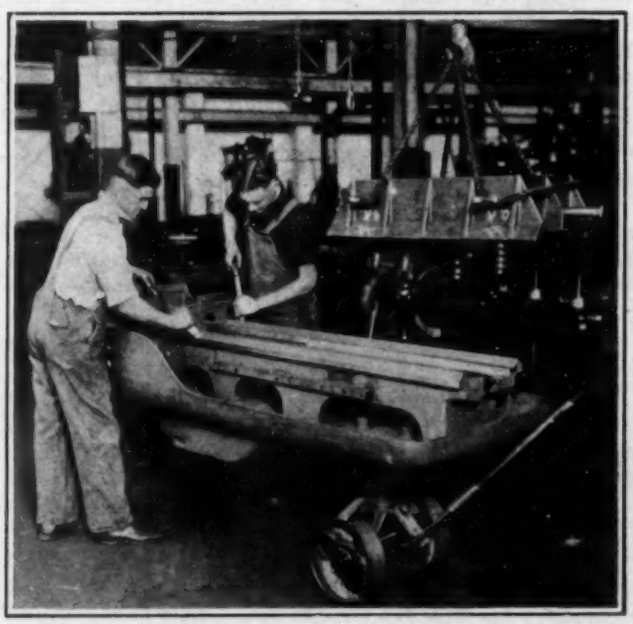


*Fig. 18—Scraping the V's of the bed*

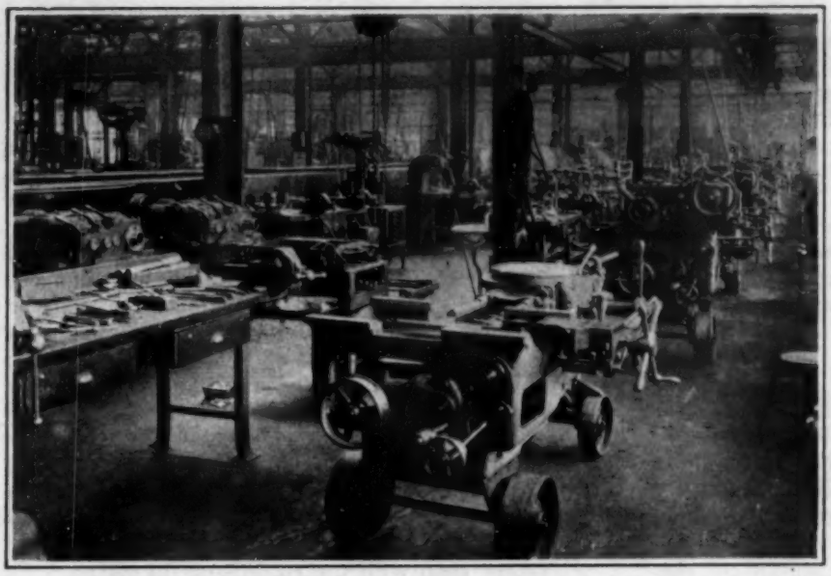


*Fig. 19—Final steps in assembly of machine*

ing clutching at straws must be eliminated from the production schedule and concentrated on the problem of getting started on time. If necessary, we must be willing to start out by dog team on a winter's night over the ten-foot snows of our Northern winter, to get from a distant foundry the castings needed to preserve the schedule! But there is no place for such desperate measures within the four peaceful walls of the machine shop.

The amount of rough stock ordered is thus determined by the scheduled rate of production and an actual count of the reserve supply. The finished-stock room is run on the same principle. When a new lot arrives in the stock room it is supposed to find a half-lot in reserve waiting there. At the earlier period of starting the lot there should be a correspondingly larger amount, and this amount is set down on the card. If the reserve stock is low, the foreman increases the normal lot to make up the deficit. If it is in excess, he correspondingly decreases his order.

*There are no stock-room records.* Both rough stock and finished stock get a complete count six times a year, and a better knowledge is obtained than is possible with all the chances for error in the clerical work of the perpetual inventory.

*The stock is under continuous control.* Orders go out from the main office to work on a production basis of 30 or 75 machines a month, or whatever it may be,

LIST NO. 7233 NO IN 2IN 2 3IN 2 2SP 0

ORDER STOCK 1 old START 10 men FINISH 25 men

| MACHINES PER WEEK | NORMAL ROUGH STOCK | NORMAL FINISHED PARTS | NORMAL ORDER | TOTAL HOURS |
|---|---|---|---|---|
| 3 | 10 | 16 | 20 | 68 |
| 4 | 14 | 22 | 28 | 92 |
| 5 | 18 | 28 | 36 | 116 |
| 7 | 24 | 38 | 48 | 152 |
| 9 | 32 | 51 | 64 | 200 |
| 12 | 40 | 64 | 80 | 248 |
| 15 | 52 | 82 | 104 | 320 |
| 19 | 66 | 105 | 132 | 404 |
| 24 | 84 | 134 | 168 | 512 |
| 30 | 104 | 166 | 208 | 632 |

*Fig. 20—Card used in routing*

and automatically the stock adjusts itself to this production. Change in scale of production is made easy by the provision of a reserve of half a lot in both rough stock and finished parts. The scheduled production on the card of Fig. 20 may be increased a step a month, or decreased at the same rate. If the proper changes in labor capacity are made to correspond, the adjustment of size of lots and size of stock takes place easily with the half-lot reserve as a balance wheel.

This is startingly different from the old order of things with us, in which shortened production left us with a large stock, and increased production with an insufficient one. There is the accompanying financial advantage that the amount tied up in rough stock, work in process, and finished parts is automatically adjusted to the scale of production. It leaves for special decision only the major financial problem of how much shall be tied up in finished machines.

As there are no stock records there is no stockkeeper. The foreman of each department oversees the putting into and taking out of the rough stock. The inspector, located beside the stock room, O.K.'s the finished work and places it in the proper bins. The bins are located opposite the point where the parts are finished and close to the point where they are assembled. One of the assembly men, detailed for the purpose, steps in and lays a group of parts on the top of the rack opposite the man who needs them when he needs them. It is possible to look down the aisle of the stock room twenty times and see a man in it only once.

This scheme of management is essentially a decentralized one. By keeping the work completely within the department from rough stock to finished stock, we avoid the necessity for detailed control of its movements, particularly with reference to interdepartmental relations. These are minimized, relating almost entirely to hardening operations. Roaming about the shop becomes unnecessary, the telephone falls into disuse, clerks disappear, and a hundred chances for confusion are dissolved.

The foreman is bounded only by his production orders and his schedule. Within these limits he is king of his territory, with full power given to him—and full responsibility demanded of him. His job is his own in a way that is never possible under the other plan of departmentalization and other schemes of management.

Mention was made of the fact that only about 80 per cent of full production per machine was reckoned with in laying out the schedule. This will ordinarily leave some idle time. When such idle time appears imminent on a machine, the foreman goes shopping for work in the special or other departments. The service parts furnish convenient "knitting work." Since it is difficult to predict the call for repair parts, this branch of the business is handled in the old-fashioned way. The foreman can usually pick up something here to fill in his idle time.

He is provided, finally, with a definite yardstick with

which to measure the efficiency of his department. The schedule requires a certain total number of hours for a given rate of output. If he requires more, he is not up to standard. If less, his management may be highly commended. In general, he will have to stick very closely to the definite routing prescribed by the schedule to maintain full production. On lessened production, with fewer men but a full complement of equipment, more latitude is allowed.

There is little need for detailed cost accounting. The cost of the machines can be determined sufficiently for price-setting purposes by reckoning on the overall operations of the shop—so much spent for steel, castings, forgings, etc., per month, so much for labor, and so much for overhead and fixed charges. This, divided by the output, gives a good cost per machine, *because the department is run on an even basis.* This simplified method of cost keeping is not the least of the advantages of this method of management; and the author believes it to be far more accurate—as well as far less expensive—than the elaborate addition of the labor, material, and overhead for every one of the several hundred separate parts.

It should also be noted that the standard schedule presupposes standard costs with a given average labor rate and market cost of material. This standard cost derived from the standard schedule, set against the actual cost obtained as above, gives another gage of achievement.

### What Has Been Accomplished

We are now working on a straight hourly rate basis. The effectiveness of workmen and foremen can in general be gaged by their ability to keep to schedule, and their rate of pay can be adjusted accordingly. The plan would, however, seem to be adaptable to premium payment, and perhaps still more so to piece-work or bonus payment. It would seem to be especially suited to the group-bonus scheme, as the whole organization is divided up into small groups, each of which has a definite section of the work assigned to it and within its control.

In the foregoing mass of details some of the principles involved are brought out clearly, others only incidentally. It may be well to recapitulate them here.

1. *Standardization of Product.* This is the first necessary step. It is the prime requirement of successful manufacture that a design of the product be settled upon which will give a wide market over a considerable period of years. This is the definite predetermined simplification of the problem which makes the solution possible.
2. *A Separate Manufacturing Equipment and Organization for the product.*
3. *Departmentalization by Product Rather Than by Process.* There is nothing new in this. It is the plan of the high-production automobile shop. The novelty lies in adapting it to a low scale of production—in our case to an extreme low point of fifteen per month.
4. *A Recurrent Production Schedule or Program.* It is this feature which permits the adaptation to small production, and also makes possible the measurement of efficiency and the simplification in control and cost accounting.
5. *Concentration of Plant.* Principles 3 and 4 can operate to cut down machine and building investment for a given production, or to increase production for a given investment. It is worth while to decrease "the great open spaces" in a shop, if only to keep the work from taking root and going to seed in them.
6. *Minimized Transportation.*
7. *Disturbing and Difficult Factors Confined to Purchasing.* So far as possible, strenuous effort is made to have material ready to start on time. Then confusion is banished from the shop for good.
8. *Visual Control of the Work Itself, Instead of Remote Control by Records.* It is less than one hundred feet from raw material to finished machine. Within this short distance the work is to be found (except while being heat treated). It cannot escape. The foreman has it under his eye until it is assembled and rolls into the shipping room. In control by records some superexecutive functionary sits at a desk and pores over cards and slips of paper. A few hours of this and the eyes glaze and the judgment falters. It is better to deal with things rather than with the records of things.
9. *Control by Orders Instead of by Records.* Records are always late. Direct the thing before it happens and save some tons of paper and miles of scribbling. And yet success in giving proper orders was only possible because we had kept records for years. Perhaps it is best to consider records as a necessary evil, to be discarded as soon as possible.
10. *Automatic Control of Inventories.* This is important. It is the very commonest of errors to put into inventories resources which belong in dividends.
11. *Cost-Figures by Analyzing Total rather than by Totaling Innumerable Details.* Cheaper and surer.
12. *A Plain Job for Every Man and Full Responsibility with it.* A man can do more, and prove that he has done it, thus establishing a basis for increased earnings.
13. And lastly: *Don't Try to Overcome Difficulties —Avoid Them.*

The general shop layout here described was devised by Mr. Henry S. Beal, assistant general manager of the Jones & Lamson Machine Co. The details of the machine arrangement and the arrangement of the production schedule are the work of Mr. Louis Hronek, assistant superintendent. Mr. George A. Perry, chief engineer, was responsible for the redesign of the product on which this method of manufacture is based, and for the mechanical details of the production scheme. Credit is also due to the personnel of the Fay lathe department, who tried out many of these methods under more difficult conditions.

## Gases in Sheet Steel for Welding

Manufacturers of oxy-acetylene welded sheet steel products (tubes, barrels, etc.), encounter certain lots of sheets which give unsatisfactory welds apparently on account of the evolution of gas as the molten weld metal freezes, according to Technical News Bulletin No. 91 of the Bureau of Standards. Samples of satisfactory and unsatisfactory sheet steel have been submitted to the bureau by a tube manufacturer, and similar samples have been promised by a manufacturer of welded steel barrels.

# Methods in a Rapid Transit Shop

By Fred H. Colvin
Editor, *American Machinist*

Special devices for handling and cleaning armatures, for pulling pinions, for utilizing pneumatic drills as drilling machines, and for putting couplings in air-brake hose

THE handling of the heavy armatures from elevated or subway motors requires both apparatus and care in its use. For armatures must be protected against damage while in the shop.

The New York Rapid Transit Corp. has worked out a very good system as can be seen from the illustrations. After the top half of the motor frame has been removed, the armature is lifted out by means of the large I-bolts screwed into each bearing cage, as at *A* and *B*, Fig. 1. The armature is then placed in one of the series of racks shown where it can be examined and worked on if necessary. The large spanner-wrench *C* is for turning the armature in its bearings by means of the teeth of the gear.

After the armature has been repaired or is O.K. for reassembly into the motor truck, it is placed in one of the small carriages shown at *D*. The carriages can be easily rolled along the floor or lifted with a crane, using the eyes in the straps shown at the side. In some types of motors the armature is removed endwise by means of the usual device, the end of one being shown at *E*.

A special pinion-removing machine is shown in Fig. 2. The armature is mounted on the truck and moved till the jaws *A*, which are carried in the frame shown, can be closed so that the flanged edges will fit behind the pinion teeth. The frame carrying these jaws can be adjusted in height by the screw *B*, to suit different armatures.

With the jaws in place behind the pinion, the handle *C*, which gives a leverage of about 6 ft., is pulled down to the left, thereby operating a cam giving a half-inch movement, pulling the pinion by that amount. The lever is then returned to the vertical position, the half-inch slack taken up by a screw controlled by the wheel *D*, and the operation repeated until the pinion is off the shaft.

After the pinion has been removed the armature is

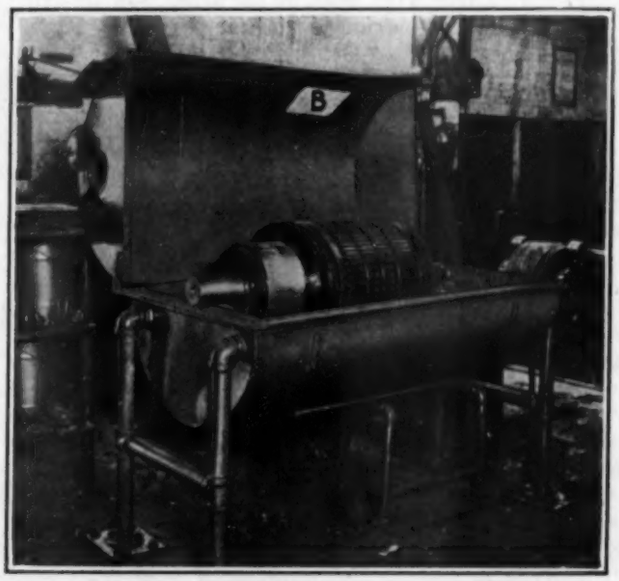



*Fig. 3—Cleaning box for armatures*

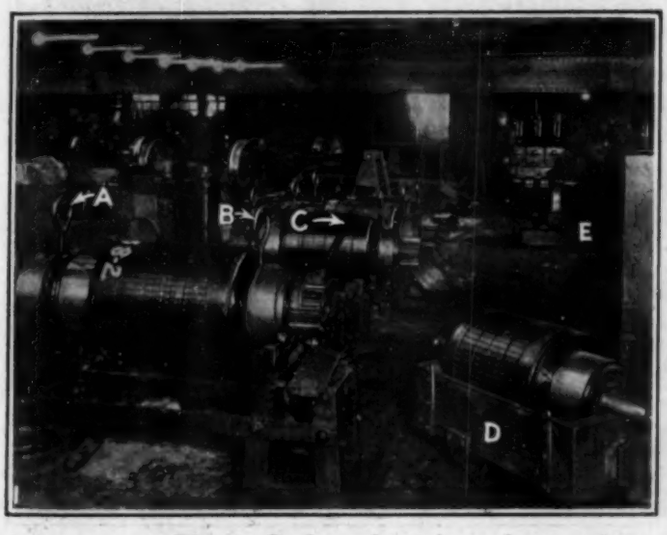



*Fig. 1—Racks and carriages for armatures*

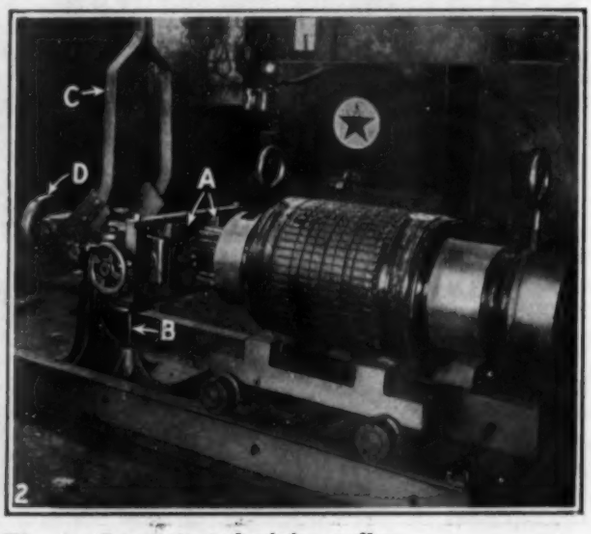
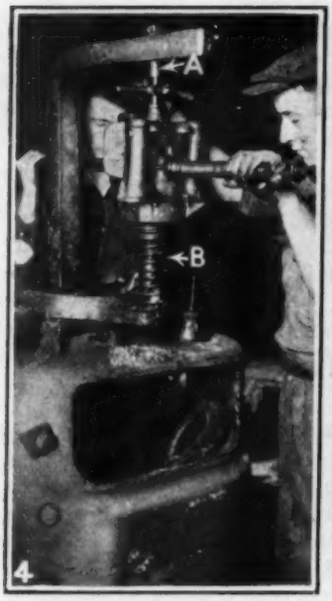



*Fig. 2—Cam-actuated pinion puller*



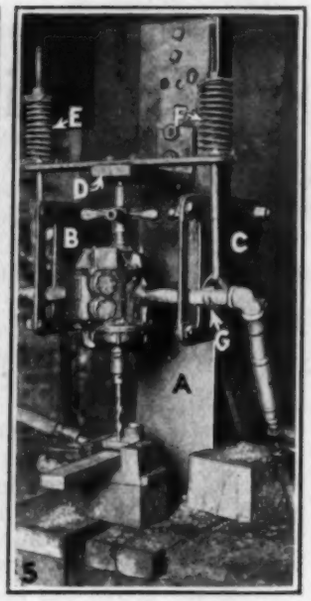




*Fig. 4—Large work with an air drill. Fig. 5—Air drilling machine*

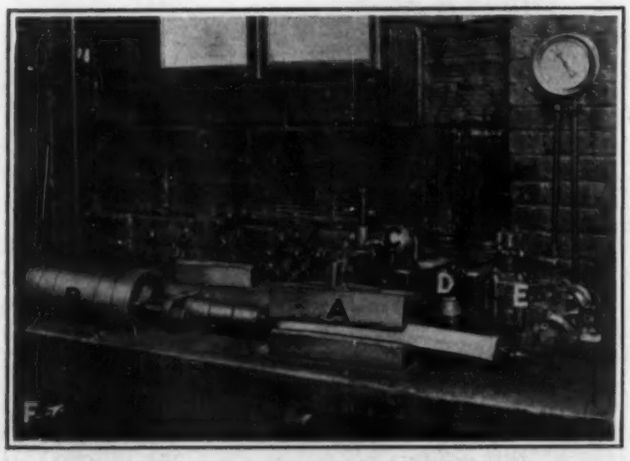



*Fig. 6—Hose-coupling clamp*

placed in the cleaning box shown in Fig. 3, the ends of the shaft being supported on rollers that can be adjusted for different lengths. The cover is then closed and a hose carrying compressed air is introduced through the opening at *A*. At the same time an exhaust fan is drawing air out of the box through a large pipe connected to the lower half of the case. This combination blows the dirt out of the armature and removes it at once, instead of letting it settle back where it came from. The opening *B* allows the operator to reach in and turn the armature so as to clean it all around but is, of course, closed as soon as the armature has been turned.

Two applications of the air drill in railway repair-shops are shown in Figs. 4 and 5. The first, Fig. 4, is the drilling of a large hole in the upper half of a motor-field casting. A substantial "old man" or brace is bolted to the face of the casting and a properly located plug *A* forms a back rest for the feed screw. The weight of the drill is partly taken by the coil spring *B*.

Another application of the air drill is shown in Fig. 5 where it takes the place of a small drilling machine. A substantial steel channel *A* forms the backbone of the device while, the side plates *B* and *C* act as guides for the drill handles, as well as for preventing the drill from turning. The thrust of the cut is taken by the steel arm *D* while the springs *E* and *F* take the weight of the drill through hooks, as at *G*.

A compact and flexible crane arrangement is shown in Fig. 7. In this view can be seen the bay where the motor trucks are disassembled and repaired and where the cranes are busy much of the time. The upper crane is of 15-ton capacity and has an operator on the job all the time, while the lower crane handles 5 tons and is controlled by pull handles from the floor.

A convenient little device for putting in new hose couplings in in use at the 36th St. shop and is shown in Fig. 6. It consists of a clamp *A* and an air cylinder *B* for forcing the couplings into the hose. The clamp is worked by the cylinder *C* which is controlled by the valve *D*, while valve *E* controls the air for cylinder *B*. The ram is pulled back by a weight acting through the chain *F*. The device can be handled very rapidly.

*Fig. 7—Double cranes in runway*

# How the Automotive Industry Has Influenced the Design of Machine Tools

By A. L. De Leeuw
Consulting Editor, *American Machinist*

Pre-automobile influences, such as the steam engine, interchangeability, high-speed steel and the electric motor—Effects brought about directly by the automotive industry

THE development of machine tools has not been along an evenly ascending line but has gone by sudden spurts and jumps. There have been long periods without any notable improvement or invention and between such periods one may note longer or shorter periods of intensive developments, often along radical lines.

The first development of machine tools, one might almost say the start of the machine tool industry, was caused by the invention of the steam engine. It is often difficult to say without looking into the history of a thing which is the cause and which is the effect. For instance, the invention of the steam engine made it necessary to develop machines capable of more or less accurate turning, boring and planing. When such machines had been developed and were applied to other work, they could not be used unless mechanical power could be had. In other words, they required steam engines. The steam engine called for machine tools and the machine tools called for steam engines.

### Influence of Interchangeable Manufacture

For a long time the development of machine tools was along the lines of perfecting the machines already existing. They were made somewhat heavier, somewhat more accurate, somewhat more powerful and with a somewhat increased range. Other developments were few and far apart.

Later on, the idea of interchangeable manufacture caused a development of machine tools along entirely different lines. Interchangeable manufacture requires a degree of accuracy theretofore supplied by the skill of the workman. This skill had to be delegated to the machine. In addition, the fact that interchangeable manufacture is of value only where there is a relatively large production made it quite natural to search for more productive methods—a search that led to automatic machinery. It also led to more or less specialized machinery. As a result a line of machinery was developed for the making of watches, small arms and sewing machines which was either wholly or partly automatic and which had a degree of accuracy unknown up to that time.

The third development, again along different lines, was started by two entirely different causes which happened to appear simultaneously: the motor drive and high-speed steel. The high-speed steel allowed of higher speeds and heavier cuts and it was often found that if advantage were to be taken of these possibilities the existing machines could no longer be driven as they had been driven, by a belt. The full advantage of the qualities of high-speed steel could be realized only if some other mode of driving could be applied and this new drive was found in the electric motor. At first this development was more or less restricted to the heavier types of machine tools but it was soon found that the same advantages could be had by applying motor drives to smaller machines. These two causes of this development had a mutual effect upon each other. Without high-speed steel, motor drives would not have found much favor; and without motor drives, high-speed steel would not be used as generally as it is.

The really striking developments had been confined so far to the heavy and to the very small types of machine tools. The heavy tools were developed along the lines of greater capacity, rigidity and power and the small ones along the lines of greater accuracy, automatic features and means for easy handling. The great middle class did not undergo so striking a development as the two extremes until the automotive industry began to make demands which could no longer be met by the existing tools of this middle class. As an instance, the heavier parts of the large machine tools could not very well be moved by hand and it became necessary to design means for moving such parts by power. On the middle class of machine tools such need did not exist until the necessity for a high rate of production brought to light the fact that a great deal of time and a great deal of effort on the part of the operator, especially the latter, were spent in work which could just as well be done by power, and at a much higher rate of speed. This necessity of rapid production was brought about by the development of the automotive industry.

### Development of Machines of Medium Size

Quantity production had been confined almost entirely to the classes of product mentioned before. Neither heavy machines nor medium machines were used for such work but the automotive industry now began to call for machinery of medium size which would produce rapidly and with a high degree of accuracy so as to make parts interchangeable.

The rapidity of a machine applies both to the cuts the machine takes and to the means for operating the machine. The accuracy of the machine calls for great rigidity and accuracy of adjustment. In addition automatic features were found to be practical in the sense of being economical on machines of a size that had been used only for small quantities and which, therefore,

could not be equipped with automatic features. Even full automatics were found to be economical.

Still another thing was the fact that the makers of automobiles realized that the existing machine tools had been developed for what may be called the jobbing shop, the shop in which a great variety of jobs may have to be given to one machine. A machine capable of taking such a variety of work must take care of a wide range of work, must have a wide range of speeds and feeds and many other features that are absolutely useless when such a machine has to do only a single job or, at the most, a few similar jobs.

### One Speed, One Feed, for a Single-Job Machine

If a machine has to do a single job only, there is no reason why it should have more than one speed and one feed. It requires means of adjustment capable only of taking up the small variations in the size of the work and due to the wear of the tool and there is no reason why its dimensions should admit of a piece much larger than the one piece for which it is intended.

The automotive industry has developed so rapidly that it is not possible to say what it has done because it is still doing it. In 1910 the total production of automobiles was in the neighborhood of 170,000 machines per year. The expected output for 1924 is in the neighborhood of 4,000,000. Moreover, this 4,000,000 are to be manufactured by a smaller number of concerns than were engaged in the manufacture of the 170,000. Even the proportion of 4,000,000 to 170,000 does not express the increase of product because the average automobile of 1924 contains a great many more parts and is of a higher quality of workmanship than the car of 1910. Notwithstanding this improvement in amount and quality of the product and notwithstanding the depreciated value of money, the average car now sells for less than it sold for in 1910. In other words, the automobile manufacturer is capable of selling a much more valuable product for the same amount of money or less. Part of this reduction may be credited to better management, but most of it has been caused by the introduction of better methods, and these methods call for tools better adapted to the work to be done.

It is sometimes thought that machine tool builders have been waked up by the automotive industry and that they should have made the present improvements in their machines long ago; that it was the automotive industry which woke them by insistent demand that they produce something better than they had been making. However, this is not entirely true, if it is true at all. Many of the machines that have been developed recently would have had no market except for the automotive industry and it would have been folly to develop them before the automobile made them necessary.

These facts do not detract from the credit which the automobile maker deserves for having brought about this development of machine tools. He had the vision to see that the automobile, which, at first, was a toy for the very rich, could be made into an article that everybody could afford.

One of the products that had to be made in unusually large quantities was the gear. If one multiplies the number of gears in the average automobile by 4,000,000 one will get an idea of the enormous proportions of this part of the industry alone. And, if one then further remembers that these gears must be of a quality to transmit enormous power under most unfavorable conditions and that they must run almost noiselessly in order to satisfy the popular demand, one will see that there is a problem larger than almost all the problems of the previous twenty-five years put together. New methods had to be developed for the making of the blanks, the very accurate cutting of the teeth and the heat-treating and hardening. An entirely new method, that of grinding the teeth, was developed and machines for that purpose invented; in 1923 alone four varieties of that type of machine were brought out.

Still confining ourselves to gears, it was found that to shift the gears along a shaft with one or two keys in it, was entirely unsuitable for the automobile and that it was necessary to make a number of keys and make them integral with the shaft. This brought about the application of the hobbing machine for such work and made certain improvements in hobbing machines as well as in hobs necessary.

Up to that time gear blanks could be made on semi-automatic machines but such machines were arranged to take in a great variety of work. Machines which were especially adapted to the narrow field of gear blanks have been developed in recent years.

One of the most striking developments of machine tools in recent years is the development of the milling machine. Though this machine still resembles the machine of twenty-five years ago, though it is still recognizable as such, it has undergone remarkable changes. The chips produced on a milling machine twenty-five years ago were fine cast-iron dust and pointed slivers of steel which were dangerous when handled without gloves. Now-a-days it is sometimes difficult when looking at the chips to see whether they were produced on a milling machine or on a planer of good size.

### Machines Formerly Special, Now Standard

Some of the machines that we would call standard at present were special machines but a few years ago. The cylinder-grinding machine and the multiple-spindle drill may be placed in this class. Though it cannot be said that the multiple-spindle drill has been originated by the demand of the automotive industry, yet it is true that it has been developed along the lines of automotive requirements. The semi-automatic milling machine, now used to a large extent, was a modification, a radical modification in fact, of the Lincoln type milling machine, made adaptable to the work of the automotive shop. The dynamic balancing machine also has found its widest application in the automobile factory and has been developed with a view to the requirements of that industry.

Automatic and semi-automatic drill presses and lathe-type machines of various descriptions have sprung up as a result of the demands of the automotive industry. As an extreme development of such machines we may mention the machines for turning the bearing surfaces, cranks and contour of the webs of crankshafts. There are many other machines that might be mentioned.

In addition to originating or developing machines as a whole, this industry has also developed certain individual features of machines. It may be said to be responsible for the introduction of power adjustments, quick traverse, and so on, on machines of medium size; of special devices for setting tools and gages, for automatic gaging devices such as may be found in an internal grinding machine recently introduced; and for many other devices.

# Tool Salvage

By L. A. Churgay
Engineer, Production Division, Maxwell Motors Corp.

## Functions of tool salvage not limited to reclaiming equipment—Adaptation of obsolete and excess tools—Reclamation of costly steels and grinding wheels

SALVAGING perishable tools has become of more than ordinary importance during the last decade, because of the increasing costs of material and labor and the necessity for economizing. The value of the tools salvaged and the prompt service the salvage department renders in supplying reclaimed standard or special tools on short notice shows that, when measured in dollars and cents, this department has an important part in present-day tool organizations.

The functions of tool salvage are not limited necessarily to reclaiming worn-out or rejected tools. Due to engineering changes in the product and to changing of manufacturing methods, many tools become obsolete. A careful survey of the tool-supply stores frequently discloses a surplus of tools that represents a considerable amount of tied-up capital. To adapt these tools for shop requirements, or to find an outlet for them at somewhere near their value, requires careful planning and good execution.

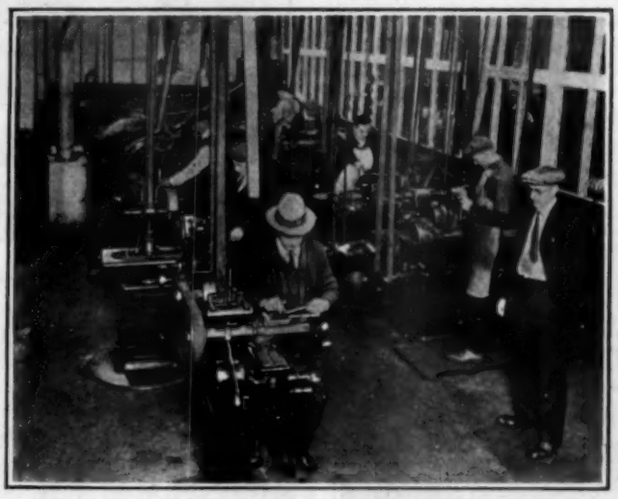


*Fig. 1—The Maxwell tool salvage department*

In Fig. 1 is shown a general view of the Maxwell tool-reclaiming shop.

Worn and broken tools are of little interest to the average tool-crib attendant. Unless he is instructed to keep the various replaced tools and supplies in separate containers provided for this purpose, all drills, reamers, milling cutters, files, wrenches, hammers, high-speed steel and stellite tool-bits, brushes, grease cans, gloves, and the like, are thrown into the common scrap-box and sent to the tool-salvage department to be segregated. This entails considerable expense. Tool salvaging having been introduced as an economic measure, it is hardly conceivable that such procedure is in accordance with the principle involved.

The tool-crib attendants throughtout the shop usually are under the direct supervision of the central stores department. They receive their instructions from that department for taking care of new tools, as well as in regard to how to handle and dispose of the accumulation of the many obsolete, broken and worn-out tools.

Ordinarily, a standard form of requisition is issued by the department foreman for the replacement of worn-out tools. These requisitions are forwarded daily by the crib man to the central stores. They are listed according to departments, the cost is entered for each item and the amounts are totaled. Copies of these reports are then forwarded to the various departments interested in the transaction.

To keep the salvage department in constant touch with current tool-needs and to enable it to dispose of the accumulated supply, all purchase requisitions for new perishable tools, are issued in triplicate by the central-stores department. One copy is retained for the file and two copies are forwarded to the salvage department. On receipt of these requisitions the salvage department makes an effort to fill in all items so far as possible, using an inter-department requisition. It is issued in duplicate and bears the purchase-requisition number. One copy is retained by the salvage department and the other copy is forwarded to the central stores department. Upon comparing the original purchase requisition with the inter-department requisition, the items that the salvage department is unable to fill will then be requisitioned from the purchasing department. To cover the cost of salvage operations, company "work orders" are issued and the numbers of these orders are entered on the inter-department requisitions.

The man in charge of tool salvage must have a broad, practical knowledge of the various tool and high-speed steels and their treatments; of the possibilities of welding and of the methods of grinding. He must possess considerable enthusiasm and constructive energy for this particular work and also have good, sound judgment in directing his efforts, so that real economies are affected and tools are salvaged at reasonable costs.

In planning to do the work on a profitable basis, the men must be trained to specialize in certain operations. For example, the man engaged in welding high-speed steel tool-bits to carbon-steel shanks or in welding new

Abstract of a paper presented at the Production Meeting of the S. A. E., Detroit, Mich., Oct. 23, 1924.

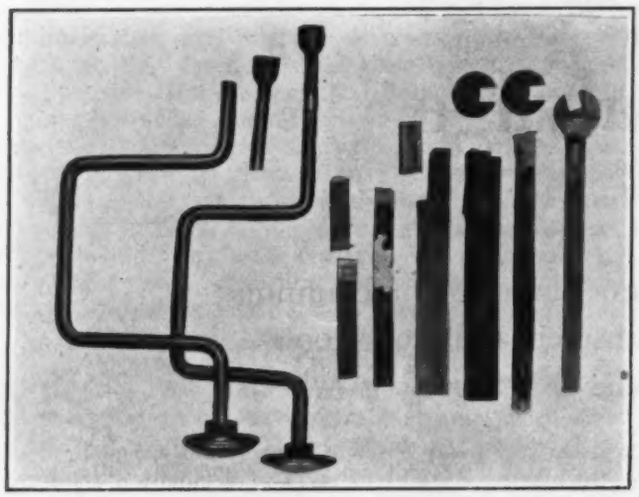


*Fig. 2—Welded tool-bits and wrenches*

heads on braces and socket wrenches, as shown in Fig. 2, and who becomes efficient in this work, must not be expected to be equally as efficient in the precision grinding of tools. However, many other jobs exist on which he can be employed, such as recasting lead

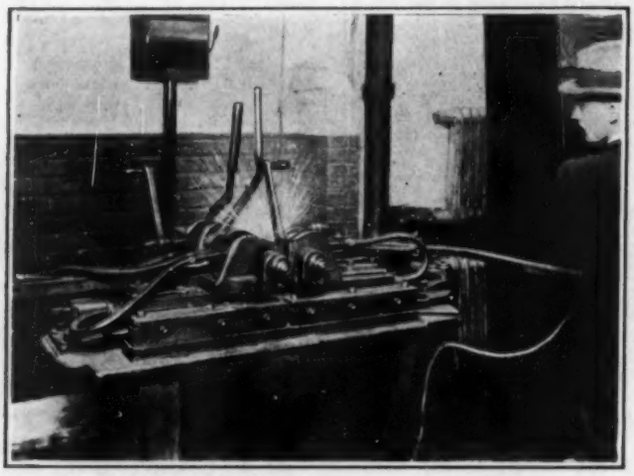


*Fig. 3—The welding equipment*

hammers, refacing copper and rawhide hammers, brushing and sandblasting files. Fig. 3 is an illustration of the welding equipment used.

In classifying the men employed in tool salvaging we have the blacksmith, the heat-treatment man, the welder, the machinist, the tool-maker, the abrasive-wheel cutter, the grinder, and the all-round bench-man.

The low scrap-value of worn-out tools stimulates the determination to find ways and means to reclaim all that is possible. The shanks of large quantities of drills are reground and reamers with broken tangs are reground to provide new tangs. Worn-out drills, reamers, counterbores, milling cutters, saws, end mills, plug and ring gages, arbors, and the like, are ground to smaller sizes, care being taken in the selection of grinding wheels and in performing the operations, so as not to draw the temper of the tool. An effort is made to make the tools as nearly equivalent to new as possible, so as to avoid prejudice on the part of shopmen. Tools salvaged in this manner are as good as new in most cases, and the cost of salvaging compared with the cost of new tools shows a saving of from 65 to 75 per cent. In Fig. 4 are shown some specimens

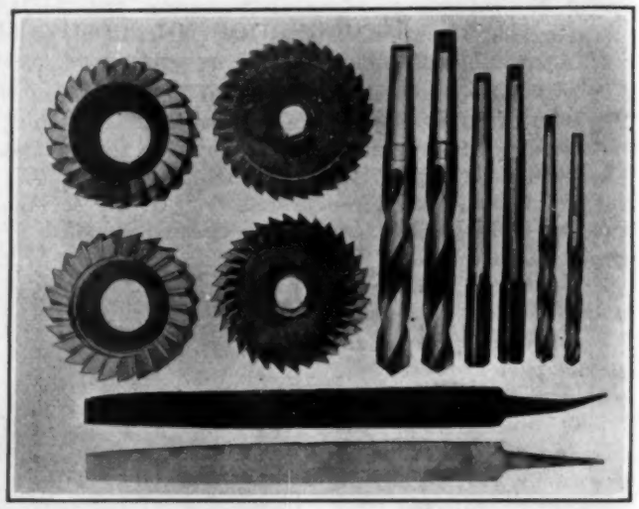


*Fig. 4—Reclaimed cutters, drills, reamers and files*

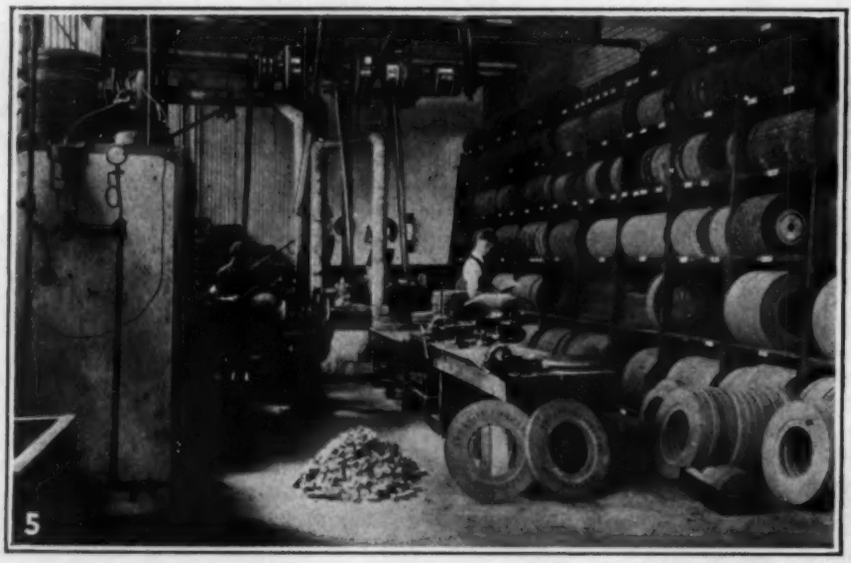


*Fig. 5—Grinding-wheel salvage room. Fig. 6—Diamonds are reset in holders*

of reclaimed milling cutters, drills, reamers and files.

High-speed steel tool-bits that are too short to be properly supported in the tool blocks are welded to carbon-steel shanks. The sides are then ground to fit the tool block, the cutting edges are ground to conform to the blue-print specifications, the tool number is marked on them and they are returned to tool stores. Considering the cost of high-speed steels, this procedure proves very profitable. Small pieces of stellite are also welded to soft steel, and considerably more than its scrap value is realized in this way.

Grinding wheels sent to be salvaged are usually rebushed and then recut to various diameters, widths and shapes to meet shop requirements. This division of the salvage department is shown in Fig. 5. Obsolete grades are disposed of at attractive figures, whenever possible. The mounting and balancing of all grinding wheels, and the maintaining of lapping heads for production purposes throughout the shop, are part of the duties of this branch of salvage.

It follows as a logical sequence that both the selection of diamonds for dressing grinding wheels and the supervision of the diamonds should also be carried on by the same department. The principal result of this arrangement was the substitution of other equally effective equipment for dressing the abrasive wheels that are used on the various jobs. An immediate reduction in the quantity of diamonds used was evident, and also a very substantial saving in cost per wheel dressing. For example, on one particular job the cost per dressing with a diamond was 0.052c. but, by using a dressing tool, this cost was reduced to 0.004c. per dressing. The actual total saving effected in diamond costs for a period of one year amounted to $18,817.39. Fig. 6 illustrates the operation of setting diamonds for dressing grinding wheels.

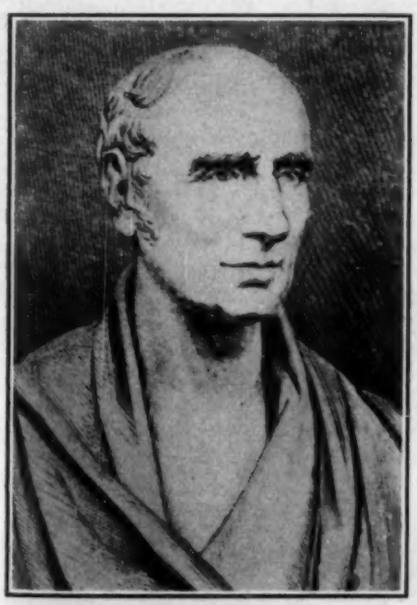
Much valuable information regarding the uniformity of grades, durability, general performance and finish produced by the different makes of wheels tried out, is complied and available for reference in our salvage reports to those who are interested further in this subject. The salvage department is not organized to attempt to set a basis for an accurate percentage of new-tool expense saved by the use of reclaimed tools. Its ultimate purpose should be its functioning with the least possible friction and the rendering of the most effective service to all other departments in all reasonable ways.

# Famous Machinists of History

By H. H. Manchester

## *William Murdock (1754-1839)*

William Murdock was born in 1754, in Ayrshire, Scotland, where his father was both a miller and a millwright. William worked in his father's shop which adjoined the mill, and soon became a skilled mechanic and an expert in handling the lathes and other tools then in use.



Two years after the partnership was formed by Boulton and Watt, Murdock grasped the fact that the development of the steam engine would halt that of the water mills, and went to the Soho works at Birmingham in order to learn the new business. Within two years he had become so skillful that he was sent to superintend the work of Watt's engines in Cornwall.

Murdock was said to have suggested in 1781, the sun and planet motion which Watt used to transform reciprocating to rotary action.

In 1786 Murdock constructed a steam tricycle which ran on the road, but was induced to lay it aside by Boulton and Watt, who had troubles enough introducing the steam engine, without trying to apply it to transportation.

As early as 1792 Murdock was experimenting with gas for lighting. After 1799 he made such progress in methods for producing, storing, and purifying gas, that during the celebration of the Peace of Amiens in 1802 he lighted the exterior of the Soho factory with gas-jets. The next year it was employed for lighting the interior of the factory, and was soon afterwards applied in some of the large cities.

Murdock retired in 1830, and died nine years later. He was undoubtedly a man of great originality, and a clear thinker, but was held so closely to the business at hand, that he had not the time to exploit his own ideas.

## Census of Screw Machine Products

The Department of Commerce announces that, according to the data collected at the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of screw machine products reported a total output valued at $39,110,582, an increase of 113 per cent as compared with 1921, the last preceding census year. The products of screw machines are numerous and varied, including machine screws of all kinds (screws for use in metal) bolts, studs, rods, rivets, collars, pins, rolls, and washers.

In addition, screw machine products are manufactured to a considerable extent as secondary products by establishments engaged primarily in other industries. The value of such commodities thus made outside the industry proper in 1921 was $3,533,575, an amount equal to 19.2 per cent of the total value of products reported for the industry as classified. The corresponding value for 1923 has not yet been ascertained, but will be shown in the final report of the present census.

Of the 179 establishments reporting for 1923, 32 were located in Illinois, 27 each in Massachusetts and Ohio, 25 in Michigan, 15 in Pennsylvania, 12 in Connecticut, ten in New York, eight in New Jersey, and the remainding 23 in seven other states.

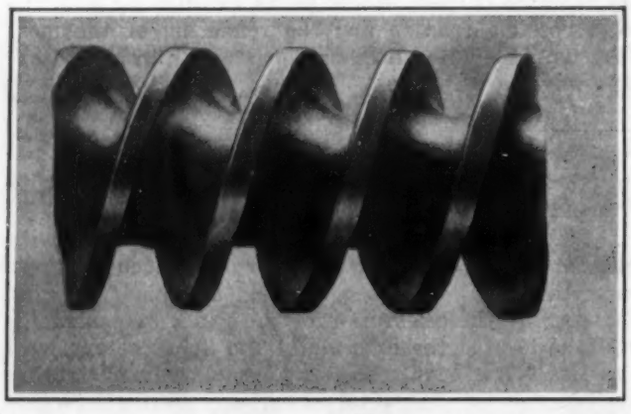
# Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

## An Unusual Thread Cut by Usual Methods

BY HENRY DENSMORE

The illustration shows a portion of a conveyor screw that is of interest because of the fact that it was made upon a standard engine lathe, and without the aid of milling cutters, dividing heads or similar appurtenances that are generally called to mind by the



*An unusual threading job*

appearance of cut helices of more than ordinary lead.

The screw from which the piece was cut off was 18 in. long and 3½ in. in diameter. The lead of the double-start thread is 2.89 in., and the depth from top to root of thread is ⅜ in. The bottom of the thread is a true radius and the sides are parallel walls.

The screw was cut on a 16-in. standard Hendey lathe, the only attachment used being the regular sub-headstock provided with those machines. The sub-headstock reduces the speed of the drive-plate to one turn for every six revolutions of the lathe spindle.

Two tools were used to do the cutting. The roughing tool removed most of the stock, while the finishing tool shaped the thread. The latter tool was of the full size and shape of the thread and its cutting edge extended around its entire contour.

## Putting Brass Liners in Hydraulic Jacks—Discussion

BY HARRY ENSMINGER

Referring to an article on page 629, Vol. 61, of the *American Machinist*, by Willis D. Northrup, I herewith submit my argument against copper- or brass-lined cylinders, and my reasons for the design shown in my previous article upon the subject which was published on page 353 of the Aug. 28 issue. I still maintain that a lined cylinder is an unnecessary evil in about 95 per cent of all hydraulic-cylinder design.

It is a well-known fact that all packings wear, and that they must be replaced from time to time. My method allows repacking without taking the ram out of the cylinder and dismantling the press, both of which are necessary when the packing is placed at the lower end of the cylinder, and involve a lot of hard labor and loss of time, not to mention possible injury to the packing surface of the ram. The U-packings can be replaced in much less time and with about one-quarter of the trouble.

I strongly advise against the use of packings on the lower end of the ram, with the necessary mechanical adjustment, and the use of copper linings in the cylinder. These linings are frequently the cause of trouble, arising from the fact that the liquid will get between the lining and the wall of the cylinder with the result that the lining is blistered and bulged into the cylinder. This causes more trouble, for if the blister is above the packing there is a liability of the lining being torn out of the cylinder, while if below the packing it will prevent the ram from returning to its proper place.

Copper is a soft metal, is easily scratched, and does not stand the wear. Further, a copper-lined cylinder must have the ram loosely fitted, and this allows the latter to be tilted, or cramped, if the load is not evenly distributed on the pressure-platform. This, in turn, brings extreme pressure to bear against the copper at two points, on one side at the top of the cylinder and on the opposite side at the bottom. The extreme pressure expands the soft copper and the upward movement of the ram forms a ridge in the metal, which aids further in stretching the lining, frequently pulling it away from the bottom of the cylinder. This results in delay at a time when it may be most inconvenient to have the press out of service, for it is more than likely that it will have to be returned to the home factory for repairs, since few other shops would have either the equipment or the experience necessary to do the work properly.

In using the U-leather, the upper end of the cylinder is counterbored to receive the packing, which should be of the best selected leather. A flat braid of hemp is placed between the lips of the U and the whole is held down by a suitable gland. The hemp braid holds one lip of the U against the wall of the cylinder and the other against the ram. When the pressure comes on, the first effect is to compress the hemp and automatically tighten the packing. The greater the pressure the tighter the packing.

The U-packing consists of but these two parts, while the mechanically adjusted packings—necessary with all lined cylinders—are complicated, being made up of as many as ten parts. The U-packing has the further advantage of being self-adjusting, so that when the pressure in the cylinder is released there is no wear of the ram on its return stroke.

## Bending Fixtures

By Herbert F. Crawford

A very clever fixture for putting two separate bends in a clutch lever was recently seen in the shop of the Conway Clutch Co., Cincinnati, Ohio. In order to appreciate the problem presented the finished lever, Fig. 1, should be carefully examined.

The levers are of bar stock and are turned to a gradual taper in an engine lathe equipped with a multiple toolblock to reduce the travel required. They are then heated in a gas furnace and placed in the fixture shown in Fig. 2, where both ends are bent at one heat.

The large end of the lever is placed in a hole at *A*, Fig. 2, and clamped with the jaw *B* by means of a screw at the back. Adjoining the hole is the bending block *C*, which is the shape of the bent lever. The bending is done by the compound levers shown at *D*. The main lever fulcrums at *E*, and carries the roll *F*,

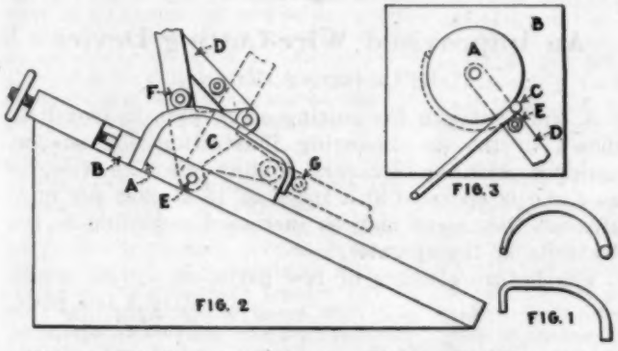



*Fig. 1—The lever to be bent. Fig. 2—Bending two curves. Fig. 3—Putting in the side bend*

which bends the rod down over the large radius of the bending block.

Then the second lever, which fulcrums in an ear of the main lever is pulled forward and its roller bends the end of the rod down over the small radius at the end as at *G*.

The side bend is easily made. The circular block *A*, Fig. 3, is mounted on a base plate *B*. The plate has a hole in which the large end of the lever is inserted at *C*. The lever *D* with its roller *E* is then swung to the left and the bend is made around the block *A*, completing the bending.

## Putting the "Pull" in the Pulley

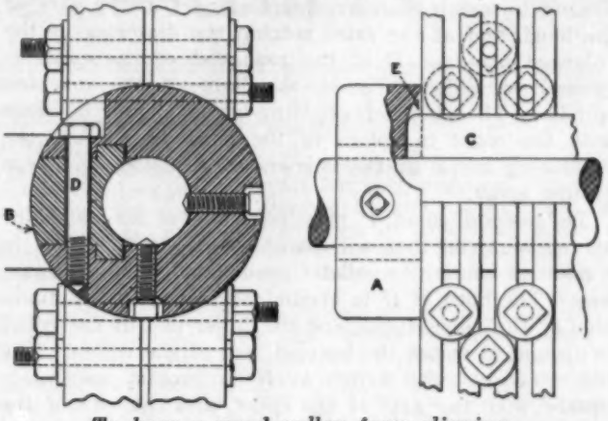
By Jim Henderson

Some time ago we experienced difficulty in keeping a large wooden pulley from slipping on its shaft. The pulley was of the split type, about 5 ft. in diameter by 8 in. face, and was located on the main shaft to drive a large drawing-press. Every time the load came upon the pulley it was accompanied by a little squeak as the pulley shifted slightly on the shaft. Tightening the bolts would relieve the condition for but a short time.

To remedy the trouble the idea shown in the accompanying sketch was suggested, and when made and applied it proved entirely satisfactory, eliminating all slip.

A large steel collar was found, the bore of which just fitted the shaft. The shaft was in a position that made it almost impossible to disconnect it to slip the collar over, as this would have necessitated the removal of a number of other pulleys and hanger bearings.

The collar *A* was cut out on one side so as to pass over the shaft, and fitted with a tongued block *B*.




*To keep a wood pulley from slipping*

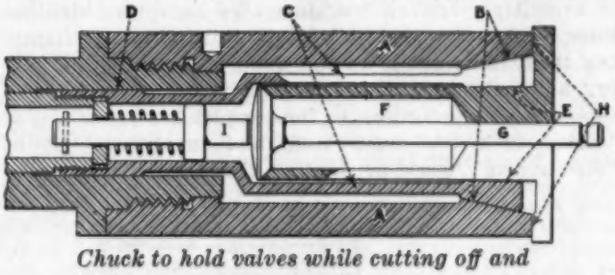
On the inner side of the collar a slot was milled across the face to fit the strip *C*, which was located between the two halves of the pulley and secured by means of the clamping bolts. After the collar was placed over the shaft, the block was inserted and clamped by bolt *D*, and then placed against the side of pulley with slot *E* located over end of strip *C*. The collar was then fastened securely to the shaft by two setscrews.

## A Chuck to Hold Valves While Cutting Off the Stems

By I. F. Yeoman

The appended sketch shows a chuck to hold the valves of automotive engines for the purpose of cutting off the ends of the stems to a uniform length, measured from the pitch line of the valve-face. It is intended for use on any screw machine that is provided with a drawback chuck operating-mechanism.

The hood *A* is threaded to fit the spindle nose of the machine and is made of machinery steel, pack-hardened.




*Chuck to hold valves while cutting off and grooving stems*

The beveled portion of the bore at *B* should be ground, preferably with the hood in place in the machine on which it is to be used, but not necessarily so. The angle at this portion of the bore should be from 12½ to 15 degrees.

The collet *C* should be made of tool steel and hardened on the large end only. Before hardening it, three ⅛-in. wide slots should be run from the large end to a point near to the shoulder reduction in diameter, about midway of the length of the collet. In sawing these slots a

small amount of metal should be left at the corners where the slots join the bore in order to maintain the rigidity of the part throughout the hardening and subsequent grinding operations. This stock may then be removed by means of a thin elastic wheel.

With the collet on an arbor, the angular surface is ground to match the corresponding part of the bore of the hood, and at the same setting the diameter of the enlarged shoulder *D* at the rear end of the collet is ground to slide easily in the bore of the machine spindle. The internal grinding at *E* should be done with the collet in splace in the hood and before the sustaining metal at the corners of the slots has been ground away.

The second collet *F* may be made of tool steel or of any material that will packharden. It is slotted in a manner similar to collet *C* and handled in the same way. The bore at *G* is ground or lapped to the diameter of the valve stems and the inner end of the collet is ground to match the beveled face of the valves. The inner face of the flange at *H* is ground accurately square with the axis of the collet, and the end of the hood is also ground.

In operation, the inner collet *F* is removed from the chuck and the valve inserted in it. It is then replaced as shown in the sketch and the ground face of the flange at *H* brought into contact with the end of the hood. This act will compress the spring back of the plunger *I* and force the face of the valve into contact with the beveled rear end of the collet.

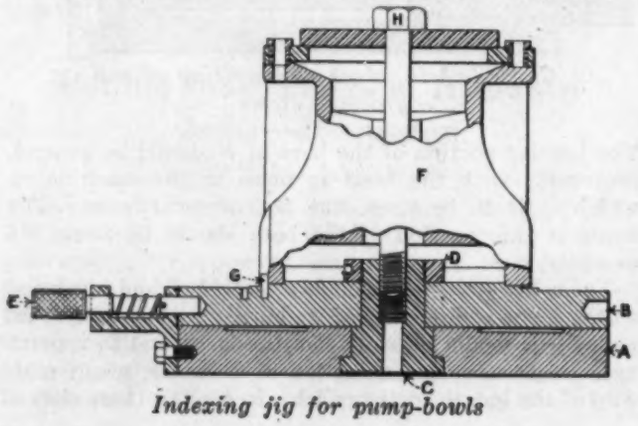
The draw-bar of the machine is then moved back, causing collet *C* to close upon collet *F* and the latter to close upon the valve stem. At the same time the slight rearward movement of collet *C* will draw the ground surfaces at *H* more firmly into contact and insure the distance from the face of the valve to the grooving and cutting-off tool is accurately maintained.

## An Indexing Drill-Jig

By Mervin J. Fulton

In our shop we have a comparatively large number of pump-bowl castings in which six holes, equidistantly spaced around the flange, have to be drilled; yet the number is hardly sufficient to warrant the installation of a multiple drilling machine. We have been drilling these castings on the radial drilling machine by clamping them individually to the table of the machine, laying a templet over the work and positioning the drill for each hole according to the templet.

This took too much time and involved a lot of "strong-arm" work in hauling the arm of the radial around and moving the saddle along it to get the drill located just right, so I designed the jig shown in partial section in the accompanying sketch and by its use we are able to cut the time in half, eleminate a lot of unnecessary labor and save a deal of wear and tear upon the drilling machine.



*Indexing jig for pump-bowls*

The baseplate *A* of the jig may be clamped to the table of any single-spindle drill press and located to bring the spindle in position to drill the first hole. Plate B turns freely on the central stud *C*, which is held in the baseplate by the nut *D*. By withdrawing the spring-actuated locking pin *E* and turning the plate B to the next position, the work is located for the next hole to be drilled.

The work *F* is located on the plate *B* by the pin *G*, which fits in a groove that normally belongs in the casting. It is clamped down by the bolt *H* from the top.

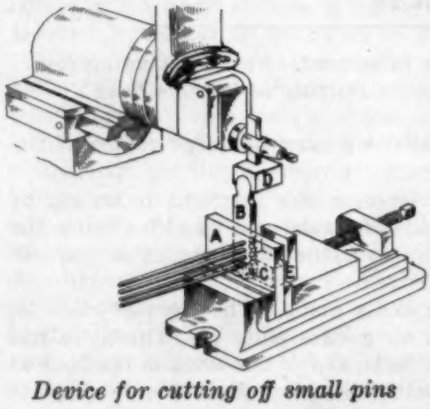
The cost of the jig was insignificant when compared with the saving in time and labor accomplished by it.

## An Improvised Wire-Cutting Device

By Charles A. Kuhn

A simple device for cutting small pins to length is shown in the accompanying illustration. A shaper, equipped with an ordinary milling machine vise, is used and is operated at a speed of 15 strokes per minute, but this speed may be increased according to the dexterity of the operator.

The fixture consists of few parts, as will be noted. Part *A* is a plate, preferably of hardened steel, having four holes drilled through it of a size that will allow the wires to be cut to slide through freely. Attached to this plate is a cutter *B*, also of tool steel, that is made to swing about the pin *C* at the bottom.



*Device for cutting off small pins*

The cutter is made with four semicircular notches on the cutting edge, corresponding to the holes through the plate. By making the cutter in this manner distortion or flattening of the wire at the moment of cutting is avoided. The upper end of the cutter is made round, as shown in the sketch, and is a working fit in the slot of the holder *D*; which in turn is held in the toolpost of the shaper. This holder is hardened, to prevent undue wear of the slot.

Attached to the side of plate *A* is a stop *E* to determine the length of the pieces to be cut off. The stop may be made adjustable, but if made solid and replaceable by others when different lengths of pins are wanted, there will be less opportunity for mistakes.

The material to be cut is placed in the four holes through the plate *A* and brought into contact with the stop. The opposite ends of the material are held together by any suitable means, such as a machinist's clamp. By operating the shaper at 15 strokes a minute and cutting off four pieces per stroke, a production of 3,600 pieces per hour is obtained.

# Technical Abstracts

## Material Handling

H. C. Perkins, of the Bloomfield Works of the General Electric Co., is general superintendent of a plant making diversified products. In many places he could avoid the time-consuming use of elevators between floors by connecting the floors with conveyors, but he does not do so because of the great expense of cutting holes through heavy concrete floors that might later have to be abandoned and others cut in a different place. Plants can rarely be especially designed for the production of a certain product or group of products, but if that cannot be done it is better to build the plant around the material-moving equipment. Conveyors should be used liberally, as in a plant so designed it is possible to use conveyors for almost all purposes.

However, a great majority of plants are gradually growing and discontinuing the making of old products to take on new ones, so that most factory executives will probably be faced with the necessity of effecting the best possible compromise. Where machines of a similar kind are located in groups scattered over a large factory area, trucks usually will move materials most economically and in assembly departments or in departments lined up on the unit plan some sort of a conveyor will pay for itself—both conditions are in operation at the Bloomfield plant. Some of the results received from installing conveyors are first, the saving of floor space; second, the reduction of labor cost; third, increased capacity without increasing the equipment; fourth, better control and regulations of operations; fifth, reduced accidents; and sixth, reduction of materials in process.

The article then proceeds to detail each of these items and states that the savings effected amounted to thousands of dollars a year by installing a proper distributing system for the factory trucks and also by having special boxes made for transportation of different parts.—*Factory*, November, p. 654.

## Measuring the Efficiency of Shop Trucks

Stewart M. Lowry, works manager's department, Westinghouse Electric & Manufacturing Co., takes up the efficiency that can be reached by closely studying motor trucking problems in internal transportation. Too many firms are satisfied when they replace manual labor with these small trucks and show a comparatively large saving, but great savings can be made by handling and operating these small vehicles along pre-determined schedules. The fundamental factors that develop trucking efficiency are maximum loads, maximum running time, minimum of empty trips, minimum damage to material, minimum of men, minimum of empty trips, minimum

How these factors are worked out in the Westinghouse shops is described in detail. There are also illustrations showing operating sheets used. Some formulas are also given for the calculation of the efficiency of the individual trucks. It is interesting to note that the variation of load, out of a total of 126 observations were empty 41.3 per cent; ¼ load 9.5 per cent; ½ load 6.3 per cent; ¾ load 5.6 per cent; ⅞ load 12.7 per cent; full load 24.6 per cent.—*Management & Administration*, September, p. 279.

## Dunlop Labor Problems

This article by D. G. Snodgrass describes the general factory council that has been found the most satisfactory way to deal with the rubber workers of the Dunlop Rubber Co., Ltd. This council is elected by the employees themselves, one representative to every 150 of their number, while the directors appoint 20 members of the management staff to represent them. Generally speaking there are two representatives of the works to one of the management. The council meets quarterly to receive reports from smaller committees and also at the express request of the workers to deal with wages. Reports of the meetings are printed in full, and discussion on both sides is given. Employee representatives can be recalled if the men feel that they are out of sympathy with them. The elections are very popular and over 80 per cent of the employees vote, which proves that the committee really gets things done.

In the mechanical section of the business there is a different organization, as the trade-unions are said to simplify labor relations. There is a works committee for each of their factories—Fort Dunlop and Manor Mills. These two committees meet together from time to time, as a joint works committee. Members of the works committee for trade-union employees do not deal with basic wage matters, although they discuss points arising out of plans for "payment by results."

Extracts from reports of meetings show the following things discussed—Grading of jobs, cupboards-cover department, education schemes, and wages. Broadly the guiding principle adopted by the committees is based on the answer to the following question—"If every fact in connection with the point under discussion were published, would an unbiased public opinion support the recommendation that we are about to make."—*System*, November p. 578.

## Die Casting

This interesting paper by Norris Clements Barnard, engineer of the Boston Pressed Metal Co., deals with the different types of die-casting machines and processes used in that art. Die casting is the art of forcing molten metal under pressure into a mold or die that remains intact for operations after the casting has been removed. The machine used must mount the die and handle the metal used in the casting, and the functions must be uninterrupted. The first die-casting industry concerned itself with type and bullets. The progress since those times has been tremendous. Originally alloy of lead was used and lead is still one of the largest metals used for die casting, but in many cases aluminum is coming to the fore because of its greater strength and lightness. The article gives compositions of lead base alloy, tin base alloy, zinc base alloy and aluminum base alloy that are suitable for die casting. The aluminum base consists of aluminum 92 per cent and copper 8 per cent. The minimum wall thickness is $\frac{1}{16}$ in. for small castings and $\frac{1}{8}$ in. for large castings. The minimum size of holes that can be cast in the metal is $\frac{1}{32}$ in. The draft need only be 0.005 in. per inch of the side walls. This aluminum alloy is used chiefly on vacuum cleaners, cameras and automobiles—it is also used in food containers.

Many types of machines are illustrated and described and the article then goes on to discuss the question of die or heat cracks. It is stated that the useful life of dies for aluminum varies from 25,000 to 250,000 casting operations.

### Where the Process May Best Be Used

In conclusion Mr. Barnard states that the process is economical where its close casting tolerances eliminate machine operations that would be necessary on castings from other processes, and the money saved on a large order more than compensates for the cost of the die, but the process cannot compete with sand castings that require little or no machining, nor can it compete commercially with simple sheet-metal stampings and simple screw machine parts.

The products of die casting are constantly becoming larger and more complicated, and at the present time the die casting of automobile body frames is contemplated. It is probably only a matter of a short time before crankcases will also be die cast. These will, of course require the construction of much larger machines than are in use at present.—*Mechanical Engineering*, November, p. 661.

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## *Impending Tax Legislation*

RUMORS of further tinkering with our taxation laws have been numerous since the election. The general impression, and it is probably correct, is that President Coolidge has been vindicated in his advocacy of the Mellon Plan by the voters and that the Congressional tax doctors have been discredited.

There is little doubt but that the Mellon Plan is the best scheme yet devised to meet the tax problem, assuming that an income tax is necessary and that tax-exempt securities will be with us for a long time to come—assumptions, by the way, that are disputed by some economists. At least it is much superior to the miserable compromise finally enacted as the Revenue Act of 1924.

We hope that the Mellon Plan will be put into effect by the next Congress but we also hope that before another tax law is written on the statute books a careful study of the principles of taxation will be undertaken so that the next law can be a permanent one. Think back for a moment and consider the changes made since the first income tax law was passed. There have been many and each one has done its part to unsettle business and clog the courts. Even a poor law that would remain unchanged for ten years would be better than the rapid shifts we have experienced, so rapid in fact, that a whole new army of experts, the tax consultants, has arisen to interpret them.

## *Service or Maintenance?*

CLYDE PELTON, Chairman of the Cleveland Section of the Society of Automotive Engineers, expressed a thought at a recent meeting which is worth considering. The word "service" is so much abused both by those offering it and those who expect it, that the time has come for something better to replace it. Too often people who see the words "Service Station" think, perhaps unconsciously but probably more or less consciously, that here is a place where one can get something for nothing or for very little. Mr. Pelton would have this word "service" changed into "maintenance." One company, the Autocar Company, has gone forth and insisted upon the term "repair shop" instead of service shop or maintenance shop. When one sees repair shop in large letters the fact is brought home that here is a work shop that will do what is wanted but expects to get paid for it. The psychological reaction leads to more profitable results, and after all, that is what we are all striving for.

There is a distinct point where free service should leave off and profitable maintenance start and the earlier this point is reached the better it is for business in all ways.

Perhaps, too, there is a suggestion here for machine tool builders who are plagued with a service problem.

## *On Building Airships*

ELSEWHERE in this issue is an article on the construction of our largest semi-rigid dirigible balloon. To some of the readers of the *American Machinist* it may seem a little out of the way of machine shop practice to describe operations on balloon cloth. These remarks are not an apology but in the nature of an explanation.

Heretofore there has been no material for gas bag construction that would compare favorably with the rubberized fabric used in this particular ship. But the time will soon come when light alloys will be applied for the purpose. Then, certainly, the construction of large airships will be a highly interesting shop problem. We have recently seen under test a large scale model of such a craft built of duralumin eight thousandths of an inch thick.

When production of metal airships reaches a commercial scale, the lessons learned in building fabric shells will be invaluable.

## *Horizontal Rate Changes are Inadvisable*

THERE are clear indications that the Congress just convening will be put under the utmost pressure to pass a bill granting horizontal wage increases to postal employees. A similar attempt failed at the last session.

Nobody expects government employees of any department to work for less than they could earn in similar jobs under private management. It seems evident, however, that a horizontal increase is not the solution. The pay connected with some postal jobs is at least as good as for similar work elsewhere. In other cases there is a marked discrepancy. Obviously a proportional increase all along the line will not equalize the differences. What is needed is a careful study and the granting of advances where they are deserved.

It is hard, apparently, for some people to learn by experience. Not so long ago experiments were made with horizontal changes in railroad rates. The results were unsatisfactory and almost disastrous, yet here we are facing another proposal of the same nature. It is to be hoped that Congress will not be stampeded into passing such a bill for the postal employees. Let a careful study of the salary question be made and legislation be based on the results of it. In no other way can the matter be handled without unfairness to somebody.

## *Just Suppose*

JUST suppose you had a trucking business employing a fleet of the finest trucks made. Wouldn't you pay a great deal of attention to gas and oil and anything else that may be required to make them work to the best advantage? Of course you would.

Now suppose you have a shop full of the finest machine tools made. Shouldn't you pay a great deal of attention to the tools you put in them? Shouldn't you keep a record of their performance, make comparative tests of different types and makes?

Well, you say, there is a lot of difference in gas and in oil, but when it comes to small tools, they are all good.

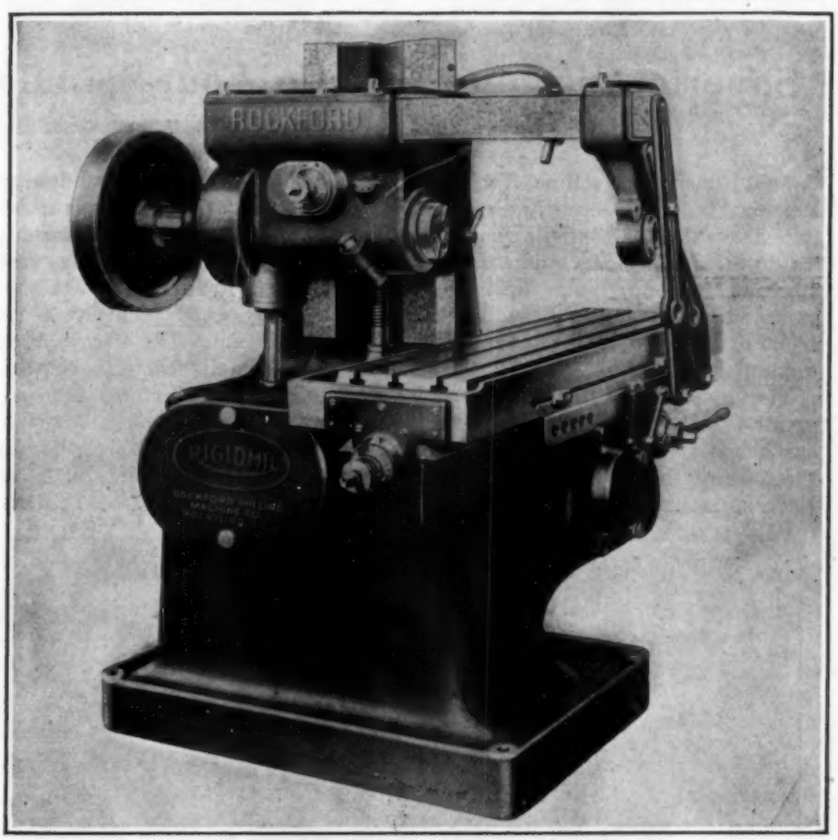
Are they? Well, maybe, but

Just suppose.

# Shop Equipment News

## Rockford Milling Machine Company "Rigidmil"

A simplified, high-production milling machine, known as the "Rigidmil," has just been placed on the market by the Rockford Milling Machine Co., Rockford, Ill. The machine is of the horizontal type and is designed to handle not only medium-size work, but also work that is usually handled on the larger types of machines.




*Rockford Milling Machine Co. "Rigidmil"*

The machine is built with a large base and a low center of gravity. It has the power and rigidity of larger machines but is compactly built with a view to conserving floor space. Rigidity is obtained by making the knee and saddle integral with the column, the adjustments being arranged in such a way as to provide support directly in line with the thrust.

The feature of the machine is the spindle head, which is moveable in a vertical direction. This design makes it possible to mill two surfaces at right angles to each other in the same setting, or to lower the spindle close to the work in order to obtain additional rigidity. A fly-wheel is provided on the rear end of the spindle to absorb vibration.

The vertical slide is built with a narrow guide in both horizontal and vertical directions and can be locked to form a solid joint. Micrometer adjustment is provided for the horizontal movement of the spindle, the vertical adjustment of the spindle head being controlled by a lever conveniently located at the front of the machine. The spindle is of heat-treated high-carbon steel and is driven through four splines, cross-adjustment being obtained by means of a quill in which both spindle bearings are carried. The bearings are of the taper bronze type and are oiled from a reservoir. A standard 3½x7-in. overarm, is used.

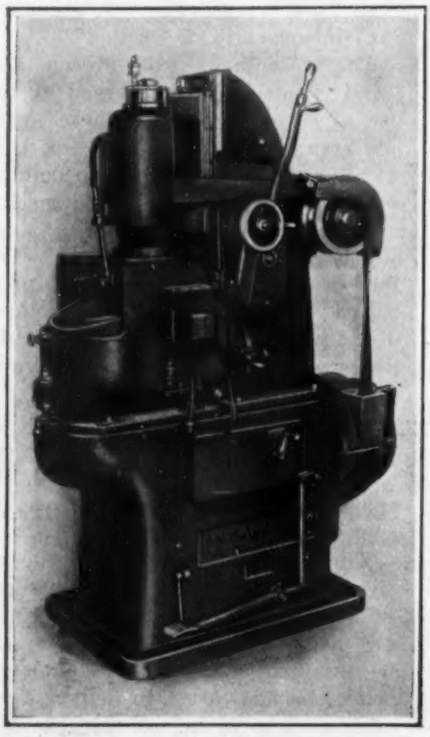
The spindle is gear-driven and speed variations are obtained by the use of pick-off gears. These gears are arranged in the speed-box that is bolted to the side of the column as a unit. The entire speed mechanism is mounted on Timken bearings and is packed in heavy grease. The feed-box is also a separate unit, bolted to the front of the column directly under the table, and delivers power feed and rapid traverse to the table in either direction. A feed control lever is located on the front of the machine. The feed mechanism is submerged in oil, the same supply serving to lubricate the table-screw.

There are but 15 gears in the entire speed and feed mechanism. Spindle speeds from 17 to 230 r.p.m. are available and the machine can be supplied with single-, double- or triple-thread worms to deliver feeds of from 1 to 7½ in. per min., 2 to 15 in. per min., or 3 to 22½ in. per min., as desired. Feed variations are obtained by the use of pick-off gears. The oiling system was designed to obviate the necessity for oiling the machine oftener than once every three months.

The machine is designed with a fixed-height table, 32 in. from the floor. This is a good height for loading the machine and eliminates the use of platforms. The maximum height from the table to the center-line of the spindle is 12 in. and the total height of the machine is 56 in. The standard table is 12x43 in. It has an automatic feeding length of 28 in., which can be increased to 42 in. by the use of an extra-length table. Cutting lubricant is supplied in large volume at low velocity through a 1-in. pipe from a centrifugal pump, and is returned to the tank in the base of the machine from the table trough. The machine can be furnished for either belt or motor drive, as desired.

# Pratt & Whitney Improved 8-In. Rotary Surface Grinder

The Pratt & Whitney Co., Hartford, Conn., has recently placed on the market an improved design of its 8-in. rotary surface grinder. Among the improved features of the machine are a longer feed lever, ball bearings on the change-gear shaft, larger passages for the coolant, fine-mesh magnetic chuck with cast-iron water guards, and an improved chuck



*Pratt & Whitney Improved 8-In. Rotary Surface Grinder*

switch. The former model of this machine was described on page 203, Vol. 55, of the *American Machinist*.

In an endeavor to make the control of the machine as easy as possible, all of the control levers and knobs are located at the front of the machine. The magnetic chuck now supplied with the machine is 10 in. in diameter and is thoroughly guarded against the entrance of water. The chuck can be detached without disturbing the other parts of the machine. A hinged spray guard surrounds the chuck and can be lowered out of the way when loading and unloading work.

The chuck mounting is hinged and has a screw adjustment for tilting the chuck. This arrangement, with a centering plug for holding the work, makes it possible to perform convex or concave grinding on washers and similar parts. The chuck drive contains a two-speed gear change controlled by a lever, and a friction clutch controlled by a treadle.

The wheel spindle is mounted in ball bearings, as in the former model. Suitable means for eliminating end play and making adjustments for wear are provided. A detachable wheel mount facilitates the changing of the wheels. The wheel used is of the cupped type and is 8 in. in diameter. The entire wheel head slides vertically on the column and is counterweighted.

Two controls for the feed of the wheel head are provided. For rough-grinding the head may be brought down quickly by means of a suitable hand lever. For fine feeding a suitable mechanism is controlled by a hand wheel and permits accurate setting and feeding of the wheel for close work. The handwheel is graduated to 0.0002 inch.

The coolant is pumped to the center of the wheel from a tank in the base of the machine and starts to flow automatically as soon as the wheel is moved down towards the work. A wheel dresser is conveniently mounted.

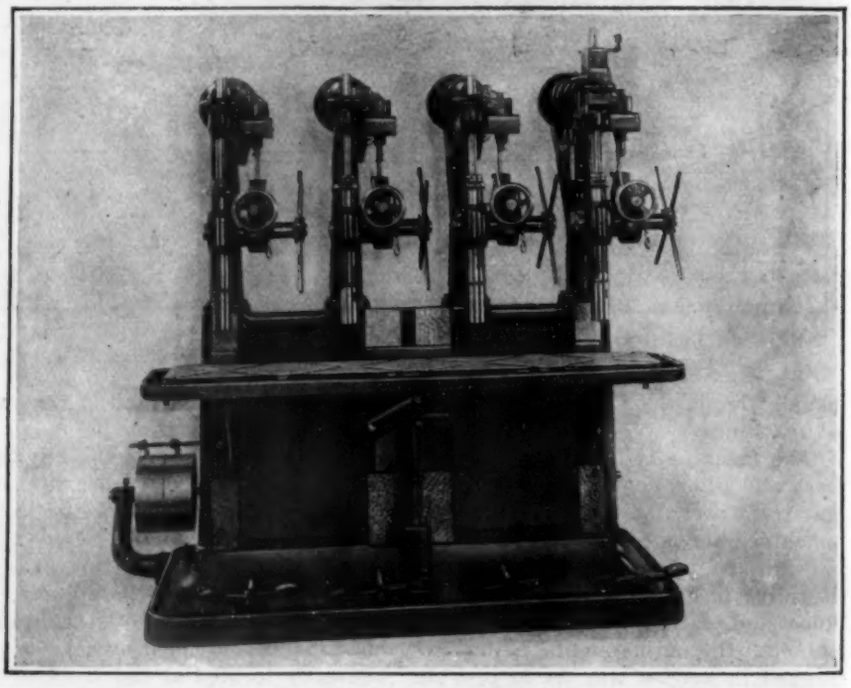
The machine can be furnished for driving by belt or motor. For motor driving a 10-hp. constant-speed motor is required and is mounted on an adjustable base. The machine accommodates work up to 10 in. in diameter and 5 in. high. The weight is approximately 3,000 pounds.

# Superior Machine Tool Co. Four-Spindle Drilling Machine

The Superior Machine Tool Co., Kokomo, Ind., has recently placed on the market a four-spindle model of its 20-in. drilling machine. In this machine the drilling units are mounted on a single base, to the front of which a single table is adjustably mounted.

The machine is belt-driven, the power being transmitted to the various heads from a countershaft near the floor at the rear of the machine. Each unit has a foot-operated belt shifter, so that the operator does not have to remove his hands from the work to start or stop the machine spindle. The work table slides vertically on scraped surfaces on the base and can be locked securely in any desired position. The lifting of the table is accomplished by means of a screw of the usual collapsible type.

The spindle and the spindle driving and feeding mechanism are the same as used in the standard 20-in. drilling machine manufactured by this com-



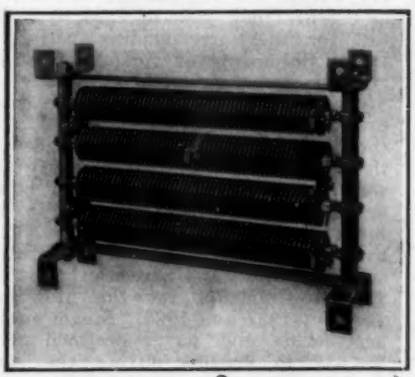
*Superior Machine Tool Co. Four-Spindle Drilling Machine*

pany. The belt from the countershaft drives the spindle through a four-step cone, and the addition of back gears gives a total of eight spindle speeds. The feed-box gears are driven through a worm gearing arrangement and provide six changes of feed for the spindle. The usual hand-feed arrangements for the spindle are also provided.

This machine is adapted for production operations as well as jobbing work, since the various heads can be set up for consecutive operations on a given piece of work. In the accompanying illustration the right-hand head is fitted with a tapping attachment, and this machine could be set up for a sequence of operations such as drilling, counterboring, facing and tapping.

## Monitor Edge-Wound Resistor

A ribbon-type resistor with the ribbon wound on edge has recently been placed on the market by the Monitor Controller Co., Baltimore, Md., and is intended for service where cast-iron grids would otherwise be employed. The unit consists of a high-resistance alloy ribbon



*Monitor Edge-Wound Resistor*

wound in helical form on a steel-reinforced porcelain support. Shattering any section of the porcelain does not affect the operation of the resistor.

The support passes through the entire length of the unit, holding each convolution of the ribbon at two diametrically opposite points. This arrangement relieves the ribbon of all mechanical strain and permits thorough ventilation. The ribbon can operate at any temperature up to a red heat without sagging or causing injury to the unit.

A system of terminals and taps permits the connection of a unit in a circuit or its interconnection with other units. Two simple forms of clamps are used for this purpose. One is a bridging clamp for connecting two adjacent units and the other may be used as a terminal clamp or a tap. The taps may be placed at any point along the unit and changed as desired.

The resistors are made in standard units and are mounted in frames, as shown in the accompanying illustration. The standard section will contain either four or six units, mounted horizontally and connected either in series or in parallel. Any number of these sections may be mounted one on top of the other.

With a very conservative rating, it is said that this apparatus occupies about two-thirds of the space required by cast-iron grids and weighs a little more than half as much. It is also stated that the resistance of the unit remains practically the same whether hot or cold, and that there is no tendency toward localization of heat.

## Johnson No. 305 Melting Furnace

A recent addition to the line of gas furnaces and appliances manufactured by the Johnson Gas Appliance Co., Cedar Rapids, Iowa, is the No. 305 melting furnace for soft

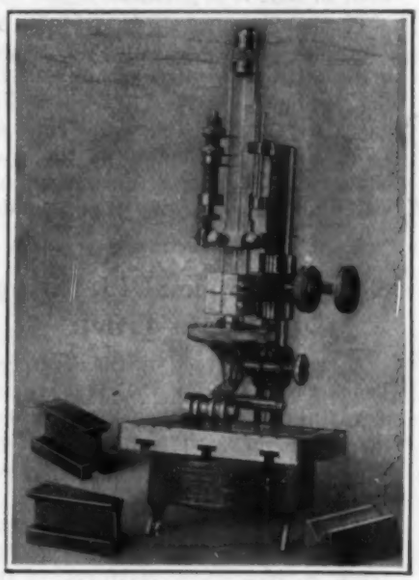
*Johnson No. 305 Melting Furnace*

metals shown in the accompanying illustration. This furnace is fitted with a removable cast-iron melting pot with a capacity for 300 lb. of metal.

The pot has a removable lid and an outlet valve for drawing off the molten metal. The heating element consists of three large direct-jet bunsen burners made by this company. These burners are said to be equal to an air-blast outfit in rapidity of heating, being at the same time more economical in gas consumption and easier to operate. The over-all height of the furnace is 31 in. and the weight complete is 185 pounds.

## Coats Improved Fluid Micrometer Gage

Several improvements have recently been made by the Coats Machine Tool Co., Inc., 110 West 40th St., New York, N. Y., in its Prestometer fluid micrometer gage. The machine is manufactured under the Prestwich patent and was previously



*Coats Improved Fluid Micrometer Gage*

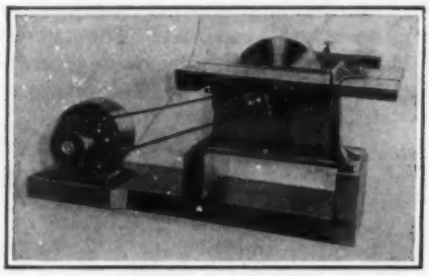
described on page 86, Vol. 46, of the *American Machinist*.

Among the improved features of the instrument are included the use of collapsible feet so that the operator can tilt the base back, and the provision of T-slots in the surface plate. The T-slots make it possible to slide the surface plate back and forth so that it can be used evenly all over its surface. The base has a longitudinal slot to make the motion of the surface plate entirely universal.

The back-stop clamping around the column can be adjusted at any angle or reversed. Parallel and taper anvils are furnished for shoulder work, together with a V-block for gaging parts ground on a centerless grinder.

## Tobrin Bench Saw

An 8-in. bench saw is a recent product of the Tobrin Tool Co., Plantsville, Conn. The device is designed for ripping, cross-cutting and mitering wood up to 2½ in. in thickness. The saw with its driving motor can be mounted on a wooden stand, as shown in the accompanying illustration, so that it is portable.



*Tobrin Bench Saw*

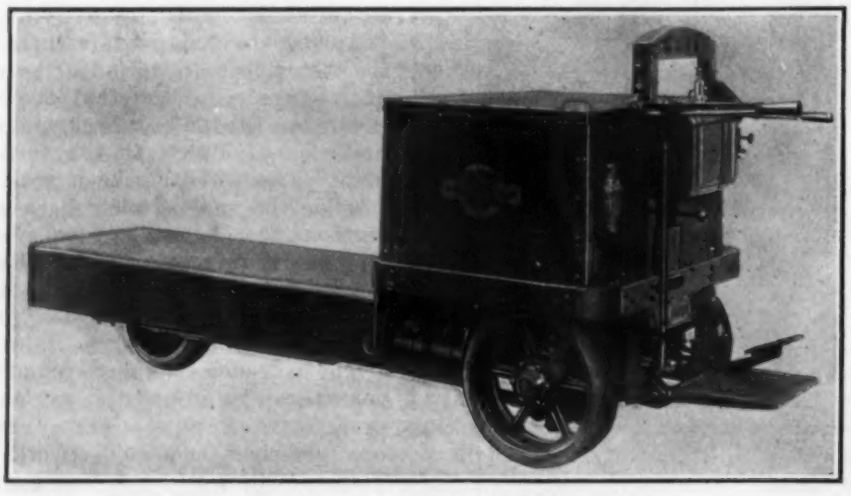
The saw-table surface is 14x16 in. The table can be elevated for grooving and tilted through an angle of 10 deg. for beveling. The driving motor has a capacity of ¼ hp. and runs at 1,750 r.p.m., the speed of the saw being 4,500 r.p.m. The shipping weight of the apparatus is 85 pounds.

## Crescent Special Elevating Platform Truck

A recent product of the Crescent Truck Co., Lebanon, Pa., is a special elevating platform truck, in which the platform is 17½ in. above the floor when lowered and 22 in. above the floor when raised.

The main feature that is an improvement over the same type of truck with a 12-in. platform, is the use of rear wheels 15 in. in diameter. This gives 6 in. of clearance underneath the platform. All the tires are 5 in. wide. The truck is designed throughout for heavy service and has a lifting capacity of 6,000 pounds.

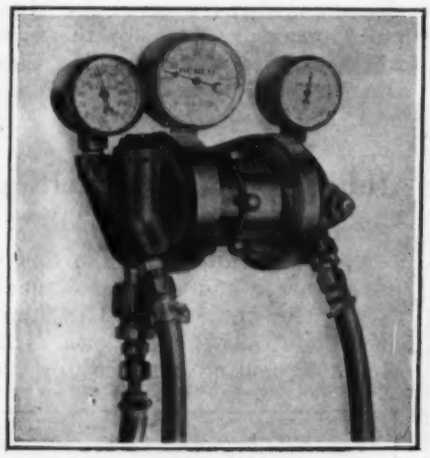
All the wheels are mounted on Timken roller bearings and the driving unit is fitted with SKF ball bearings. The controller is a product of the Cutler-Hammer Manufacturing Co. and General Electric motors are used. The loading platform is 70 in. long and 26 in. wide.



*Crescent Special Elevating Platform Truck*

## Burdette Automatic Two-Gas Regulator

The Burdette Manufacturing Co., St. Johns Court at Fulton St., Chicago, Ill., has recently developed and is now marketing a safety, automatic, equal-pressure, two-gas regulator. The device is designed to produce equal pressures in two gas lines with one hand control, and it is especially adapted for use with oxyacetylene apparatus.



*Burdette Automatic Two-Gas Regulator*

The handwheel at the center of the device is turned in the proper direction to equalize the pressures. This is done by exerting pressure on the two controlling diaphragms through the compression of a single coiled spring. There is no possibility for the gases to mix in the regulator, as they flow in independent passages to the mixing chamber in the torch. The device is screwed to the oxygen tank and is connected to a tube leading from the acetylene tank.

## Machinery Exports to Japan Gain

Reaching total figures of $6,314,516 for the six-month period ended June 30, 1924, industrial machinery exports from the United States to Japan have increased approximately 17 per cent over the corresponding period of 1923, when total shipments amounted to $5,387,710, according to the Industrial Machinery Division of the Department of Commerce. This is a partial recovery from the decline in 1923 when exports of American machinery to Japan dropped nearly $2,500,000 from figures of $14,256,017 for 1922. Types of machinery which have shown favorable increases during the current year are power-generating machinery, except electric, construction and conveying machinery, metal-working machinery, and other miscellaneous industrial equipment.

POWER-GENERATING GROUP

Exports of power-generating machinery, except electric, rose from $390,747 in the first half-year of 1923 to $579,416 for the corresponding period in 1924. Shipments of steam boilers increased from practically nothing to $48,995; internal combustion engines over 10 hp. gained from $32,151 to $84,047, while other gains in the power-generating machinery group were injectors, gages, and other boiler accessories, from $14,720 to $58,614; mechanical drive turbines from $195,259 to $218,227, and internal combustion engine parts and accessories from $1,030 to $59,811 for the first half years of 1923 and 1924. Steam engine accessories and parts declined from $54,812 to $26,695 during the same periods.

American exports of construction and conveying machinery to Japan which declined $600,000 in 1923 compared with 1922, increased approximately 26 per cent during the first six months of 1924 over the corresponding period of 1923.

Exports of metal-working machinery which increased slightly in 1923 over 1922 increased 78 per cent in the first half of 1924 over the same period in 1923. Exports of lathes nearly doubled during these periods; exports of milling machines gained from $9,975 to $68,019, boring and drilling machines from $14,890 to $52,829 and thread-cutting and screw machines from $6,846 to $51,836.

In 1923 Japan ranked third among the countries of the world as a market for American machinery, following Canada and the United Kingdom. Japan ranked second in 1922, absorbing more than $14,000,000 worth of industrial machinery from the United States.

# News of the Week

## Hoover's Report Shows Great Activity of Commerce Department

### *Many divisions prove very valuable to industrial progress*

The report of the Secretary of Commerce, Herbert Hoover, recently made public, is an encyclopedia of the commercial activities of the United States. Its 200 pages are crowded with evidence of the assistance rendered to our commerce by the Department of Commerce, and it is pointed out that our business men have hardly begun to realize its possibilities as an aid to their business problems.

It is impossible to even outline all the activities in any review of the report. The keynote is prevention of waste. Much space is devoted to the different angles of the subject. Purchasing specifications, improvement in technical processes, the accomplishments of the Simplified Practice Division and other items are well worth a careful and thorough study.

The report points out the good work that can be done by trade associations along the line of the elimination of waste in various industries. While a few trade associations have been cloaks for the restraint of trade, it states, the great majority have been active in collecting statistics of actual production, stock on hand, capacity and other data which enable an industry to judge future demand and supply. Standardizing of sizes, elimination of types, and establishing grades greatly reduce the amount of capital that must be tied up in stock, both by the maker and dealer, the report points out. The elimination of injudicious credit, the collection of accounts, arbitration of trade disputes, stamping out unfair practices, economy in handling insurance, improving welfare of employees by better conditions, and many other factors are considered.

Of the 17 commodity divisions of the department, the automotive industry is one and industrial machinery is another. As an indication of the service rendered, there were over 9,000 contacts with the automotive industry during the year. The greatest single enterprise, perhaps, was the inauguration of an automotive foreign trade manual consisting of a loose-leaf binder and geographical index, with information sheets from all automotive markets. This is issued weekly. Over 550 pages were issued during the year covering basic information on most countries and containing merchandizing data of great value. The manual has about 400 subscribers.

#### Machinery Division

The industrial machinery division has also increased. A personal investigation of European conditions was made by the chief of the division. The inquiries regarding machinery increased more than 60 per cent over last year and there were 217 visitors, both American and foreign, who were assisted in their work. Articles were furnished to trade journals, showing what had been accomplished by American manufacturers abroad, in the face of keen competition. Foreign students of engineering have used this division considerably in securing data on machinery and have been encouraged to do so. Another closely allied division is that devoted to iron and steel, which is served largely by the *Commerce Reports*. Exporters have also found this division of great assistance and manufacturers are beginning to realize its value to them.

Secretary Hoover also calls attention to the need for proper regulation of aviation having in view primarily the safety of life of both passengers and pilots and the orderly conduct of air navigation. He points out that the United States is not keeping pace with other countries owing to the lack of encouragement for builders of aircraft and accessories, as well as for those who are interested in establishing air travel as a commercial enterprise.

Some idea of the extent of the department and its activities can be had from the table showing the personnel and its distribution.

PERSONNEL OF DEPARTMENT OF COMMERCE, 1924

| Bureau | Permanent | | Temporary | | Grand Total |
|---|---|---|---|---|---|
| | In District of Columbia | In Field | In District of Columbia | In Field | |
| Office of the Secretary | 121 | ... | .. | ... | 121 |
| Bureau of the Census | 711 | 742 | 92 | 223 | 1,768 |
| Bureau of Commerce | 596 | 586 | 25 | .... | 1,207 |
| Bureau of Standards | 754 | 30 | 8 | 9 | 801 |
| Bureau of Fisheries | 63 | 324 | 2 | 178 | 567 |
| Bureau of Lighthouses | 38 | 5,415 | .. | 281 | 5,734 |
| Coast and Geodetic Survey | 314 | 518 | 19 | 31 | 882 |
| Bureau of Navigation | 40 | 174 | 1 | .... | 215 |
| Steamboat Inspection Service | 15 | 347 | .. | 3 | 365 |
| Total | 2,652 | 8,136 | 147 | 725 | 11,660 |

## Weeks Asks for More Airplanes

In the annual report recently submitted to President Coolidge by John W. Weeks, Secretary of War, the need for a larger appropriation for the air program and the necessity of keeping a good sized, although not too large, standing Army is pointed out. Secretary Weeks states that economy is commendable, whereas too much economy is apt to weaken our defenses and make us easy prey for other countries with large military forces.

The matters of keeping our ammunition reserve up to a certain standard and planning on its almost instant manufacture in times of stress are discussed in the report.

"During the World War aviation came to play an important part in military operations," the report states, "yet in our country measures have not been taken to keep step with this progress. In common with the rest of the Army, the personnel of our air service has been diminished. Aircraft has not been manufactured in any appreciable quantities to take the place of the types produced during the war. For lack of business our aircraft industry is languishing."

## Alexander Is Head of Conference Board

It was announced at the offices of the National Industrial Conference Board, 247 Park Ave., New York City, that the board has become incorporated under the incorporation laws of New York State. Magnus W. Alexander, formerly managing director of the board, now becomes its first president.

Mr. Alexander, who has directed the organization since its inception in Boston in 1916, is a well known figure in industrial administration, not only on account of his many writings and speeches upon the industrial and economic life of the United States, but also by reason of his long association with American industry and especially the General Electric Co. as an engineer and manufacturer.

Frederick P. Fish, a member of the American patent bar, remains chairman of the board, Loyall A. Osborne and John W. O'Leary are the vice-chairmen, and Fred I. Kent is the treasurer of the board. Charles Cheney continues as chairman of the board's executive committee.

# Notes on Washington Activities

## By Paul Wooton

An effort is being made by the Interdepartmental Patents Board to compile a list of all patents with which the government is concerned. There are several thousands of these patents. This is the first effort which has been made to centralize full information in connection with government patents and patent rights which it has acquired from outside the government service. The text of the questionnaire which has been submitted to all government agencies operating patents is as follows:

1. Inventions and Patents of Employees:

List of all patents, giving dates and serial numbers, back to June 25, 1910.

List of pending patent applications, with dates and serial numbers.

List of applications under Act of 1883 and form of dedication.

List of patents dedicated or assigned to the government.

Name and status of patentees under first three headings.

Special rights, if any, given government under first two headings.

Nature of government's contract rights, if any.

Licenses, if any, granted to the government under first and second paragraphs and by the government under fourth paragraph and form of licenses.

Attitude of department, or bureaus, toward inventions evolved in bureau's field of work at employee's own initiations and expense and in his own time.

Attitude of department, or bureaus, toward inventions made in the regular line of work and in government time and at government expense.

Rewards, if any, granted for inventions.

Method employed by department, or bureaus, to protect payments or patent rights comprehended under this paragraph.

2. Inventions, Patents and Patent Rights Acquired from Outside the Service:

List of all patents acquired and still active, with names of inventors or prior assignees, serial numbers and dates.

List of pending applications assigned to the government, giving serial numbers, dates, patentees and form of assignment.

List of licenses granted by the government under patents referred to under first paragraph and form of license.

List of licenses or other rights acquired by the government under patents of outside inventors, with reference to the patent, its serial number, date, and name of inventor or assignee, and form of license.

Attitude of department, or bureaus, toward, and procedure with regard to, inventions and patents arising in co-operative work between government employees and outside inventors.

Forms or methods used concerning inventions and patents in making development contracts for work to be carried on by outsiders for the government.

Statement of form of patent warranty contract in dealing with contractors.

Method employed by department, or bureaus, to protect patents and patent rights comprehended under this paragraph.

This effort is made very difficult because the Interdepartmental Patents Board has no appropriation and under the law may not borrow personnel from other service. All of the work which is being done is confined to that which the members of the Board can contribute personally.

Immediately on the convening of Congress an effort is to be made to induce the Senate Committee on Patents to take up for consideration the bill which will empower the Patents Board to handle all matters pertaining to Government patents and the patent rights it may acquire. The bill also authorizes it to issue non-exclusive licenses. Even if the controverted portions of the bill, which the Interdepartmental Patents Board has recommended should not be enacted at the short session, it is hoped that an appropriation will be authorized so as to permit the Board to engage in fact-finding activities.

If there ever were a case where the right hand has no knowledge of the doings of the left hand it is in the matter of government patents. One bureau seems to have no knowledge of the patents under which another is operating. It is said to be necessary to centralize information in order to prevent competition between departments for the same rights. The situation is such, it is declared, that one department well might buy rights which already had been acquired by another.

As this is written no member of the Patents Board is in a position to anticipate just what it will be possible to do at the short session, as they have not had an opportunity to confer with the members of the patents committee.

## Car Loadings Still at Record Pace

Continued heavy movement of grain, coal, merchandise and miscellaneous freight resulted in total loadings of 1,015,704 cars in the week to Nov. 15. This is an increase of 21,200 cars, compared with the previous week, and was 23,654 cars more than were loaded in the corresponding week of 1923.

HIS SHIP COMES IN

—New York Evening Post.

# France Discusses Its Industries

## Recognition of the union of Soviet—Limiting the number of engineering students — Encouraging apprenticeship—Inability of regulating working hours internationally

### By Our Paris Correspondent

POLITICS will perhaps play an even more important rôle in French industrial progress during the next few months than ever before. Two big issues are looming on the horizon. The effect of the fall of the Labor Party in England will have its repercussion sooner or later in France in the demise or the remaking of the Herriot cabinet; next, the results that, foreseen or otherwise, which are bound to come from the French recognition de facto of the Union of Soviet Russian governments, with Rakowsky's advent in France and a French ambassador at Moscow.

Incident to the latter arrangement the French metallurgical, machinery and tool trades look for big business developments in the East. Tchitcherine has made the following statement that has been received with optimism in France: "The concessions offered by the Soviet governments to France will find a ready response by permitting French metallurgy to find a ready outlet with us which was hitherto closed. This, of itself, will help one of the most critical situations to be found in all French industrial enterprises" The avowal is eloquent, whatever may be its real signification, as it is moreover a traditional saying of Wall Street that general prosperity depends upon prosperity in the metal trades and industries. The geographical change of venue means nothing.

#### Less Engineers Needed

There is a movement on foot to reduce the number of engineering diplomas granted annually by the three big French government technical schools, it being considered already that there is an overplus of this talent available whatever may be the shortage of unskilled labor. Contrawise, the Technical Education Bureau of the government is to make an effort to encourage the apprenticeship system in all trades. Manufacturers in certain special lines, which will above all include the machinery trades, will be called upon to make slight sacrifices in order to found a new *corps d'elite* of all round workers which shall actually have foreman capacities to take the place of those of older generations who are continually, for one reason or another, dropping out. A slight tax, ingeniously imposed to this effect, is expected to produce a hundred million francs a year to be devoted in some form, not yet specifically laid down, by the Secretary of Technical Education, to the apprenticeship cause which has, in spite of tradition, so languished of late.

There is talk of a Franco-German metallurgical alliance from the ore in the ground up to the most varied of manufactured forms. A communiqué which appeared in the *Voss Zietung* states that the French *Committee des Forges*, with M. de Wendel as spokesman, and the Ruhr Group in Germany, with Thyssen at the head, have invited other European nations to enter the consortium, but that Luxembourg and Sweden have alone responded, Belgium has not yet given its reply and England has met the proposition with a blank refusal. Monsieur Loucheur is claimed as parent of the idea originally and it may be said that it is not without merit for the parties interested, whatever may be the dire consequences for the rest of the world. At this same moment France views with fear and trembling the possibility of an Anglo-German commercial treaty which, to tell the truth, few British manufacturers seem really to want, though the matter has been discussed pro and con for many weeks in British government circles.

#### Selling Steel Cheap

Parallel with the foregoing, the French De Wendal Steel Works, as a result of the Franco-German agreement, are offering steel plates in German territory at 124.30 francs the ton, a figure lower than German producers have yet offered on their own ground, a better figure by some seven gold marks, say $1.75 per ton.

Nine months of French imports in 1924 exceeded those of the same period in 1923 by 777,985,000 francs from the United States; from Great Britain there was a decrease of 213,453,000 francs, while from Germany there was recorded an increase of 887,614,000 francs.

French exports increased 525,405,000 francs to the United States (the balance of trade in favor of the U. S. A. being, however, 252,580,000 francs to date out of a grand total of 4,024,415 francs): to Great Britain the increase was 1,325,293,000 francs, and to Germany, 1,986,618,000 francs.

#### Laboring Hours

The labor ministers of France, Great Britain, Germany, and Belgium, meeting at the League of Nations conference just before the fall of the Mac Donald cabinet in England, focussed attention on the ratification of the convention arrived by the Washington labor conference with respect to the eight-hour day in 1919. As a result of the pourparlers it was evident that Germany was working longer hours than France, from which quarter was ventured the opinion that it was impossible for any international association to interfere with the interior economics of the nation, however desirable it might be to arrive at a common accord. Even if a speedy ratification is arrived at, the workings of the law, by reason of the multiple derogations which have been woven into it, are considered by the French as being dubious of effect at least. Only industry is affected by the law—general commerce, shipping, professional and agricultural workers being beyond the pale.

It is insisted in certain quarters, encouraged by the consultative committee of commerce of the French parliament, that the French tariff be reclassified, which will undoubtedly put certain manufactures into higher protected classes than at present, whereas today they enter under generic classification of articles of steel, iron and wood in only too many instances. It is not proposed to reduce or increase the tariff or its co-efficients, but the move envisaged is sufficiently important of itself to warrant watching closely by those interested.

In view of the liquid economic and political situation it appears more evident than ever that the problem, in part, is one that has its base on the supply of labor and the incident application of an appropriate wage scale. There is a proposition now before parliament for the founding of a foreign labor bureau under the Ministry of Foreign Affairs, independent of the present Ministry of Labor, which shall guarantee a constant floating supply of foreign labor, both specialist and other.

#### Temporary Immigration Regulations Favored

Immigration under a special temporary regime of its being allowed to remain in the country only so long as this special labor may be needed is the chief plank of the program. This is considered as one of the most radical measures ever adopted by any government to date in attempting to deal with the full utilization of its resources. As the bulk of this labor will avowedly be of the non-skilled variety, it is difficult to see how this will affect favorably the high class manufacturing industries of iron and steel, textiles, chemicals and others.

France exported 31,584 passenger automobiles in the first nine months of the present year and imported 9,913, the latter, however, an increase of 3,500 from the year previous, the United State accounting for 8,885, England 10, and Germany 7. England took 5,565 of the exports and Germany 3,849. The export of this specialty, including commercial vehicles, were valued at 1,012,955,000 francs as compared with 567,262,000 of the year before.

Engines, boilers, machinery and tools imported from the United States in the first eight months of the present year totaled 324,853,000 francs, which was an increase of more than ten million francs over 1923. Export of like product to the United States amounted to 24,251,000, an increase of approximately six million francs.

# The Business Barometer

## *This week's outlet in Commerce, Finance, Agriculture and Industry based on current developments*

**By Theodore H. Price**
Editor, *Commerce and Finance, New York*

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ALTHOUGH Thanksgiving Day gave Wall Street a chance to catch its breath, there is no abatement of the optimism that has prevailed since the election and the stock market has almost reached the condition in which speculators advise each other to buy "A. O. T.," meaning thereby "any old thing."

Last week the demand shifted to the steel stocks. Under the leadership of "Steel Common" and the influence of Judge Gary's cheerful outgivings most of the speculative steel stocks have advanced sharply. From Pittsburgh and the other steel manufacturing centers of the country very roseate predictions are being received and, while it is admitted that the orders now being entered come chiefly from the railways, it is expected that the automobile companies and other large users of steel will soon be in the market again.

But this is not to say that there has been any lessening of enthusiasm for the railroad stocks. In the imagination of many speculators the railroad map of the United States has been entirely re-made by consolidation and it is now asserted that Congress will be persuaded to pass a bill that will permit the consummation of the combinations planned under the protection of Federal charters. This of course is an irridescent dream and it is only mentioned to show how far away from the reasonable probabilities the public mind is being carried by the prevailing excitement.

Sometime there will be a change of sentiment and a reversal of the present tendency, but it must be admitted that the market has thus far shown itself invulnerable to adverse news. Even the Egyptian crisis which might have caused a decline under different conditions has been bullishly interpreted and in London as in New York it is counted as another triumph for the forces of capitalism.

One of the ultimate results that is especially interesting to America is that Great Britain's insistence upon the unlimited irrigation of the Soudan may mean a considerable increase in the cotton production of that region. Upon the strength of this probability the stocks of the Anglo-Soudanese plantation companies have had a sharp advance and Lancashire has been correspondingly cheered. Per contra, the market for American cotton has been somewhat easier and the dry goods market is quieter upon the circulation of increased estimates of our cotton production for this season.

Some predictions that 14,000,000 bales of lint cotton will be ginned are now to be heard and, while they are not seriously considered as yet, the effect has been to chill the enthusiasm of the bulls who operate in the cotton market.

### *What's Doing in Industry*

**Definite improvement was recorded in all parts of the country in the machinery and machine tool industry last week. Possibly the best way to show the extent of better business is to quote reports from various parts of the country:**

**December opened better than any month this year.—Milwaukee.**

**Best two weeks in eighteen months.—New England.**

**General tone of machinery market is satisfactory.—Chicago.**

**Unmistakable signs of improvement.—Canada.**

**Machinery and machine tool business expanding.—Indianapolis.**

**Much evidence that the machinery business will be considerably better.—Buffalo.**

**Inquiries coming in steadily.—New York.**

**Dealers more optimistic than in some time.—Detroit.**

**These and other opinions presage a business in January and February that has not been equaled since the peak of 1920 and most machine tool makers are preparing for just such a condition. The first two months of the year are usually good, and added to the normal business, machine tool builders assert, will be the impending increases.**

**Railroads, automobile makers, and general industrials were in the market strong enough during the past week to give the dealers something beside promises and several orders of good size were recorded.**

In the other commodity markets the developments have not been especially significant. The persistent strength of wool is, however, causing some concern. It is now about as high as it was during the war and there is a fear that the result may be a decrease in the consumption that will mean great hardship in the woolen department of the textile industry.

The high prices are hard to explain except upon the theory that in Japan and other parts of the Orient there has been a great increase in the use of woolen garments. But this theory, though plausible, is as yet without statistical support and the woolen manufacturers of this country and Europe are meantime keeping very close to shore in their purchases of the raw material.

If a trade boom is coming the demand for commercial loans does not show it yet. The railroad traffic as indicated by car loadings and earnings is, however, large and it may be that we will get the predicted increase in business later on.

But an increase in consumer buying is a condition of the widely predicted improvement that is now being discounted in the stock market and it remains to be seen whether such an increase can be brought about with prices at their present altitude.

The one thing in favor of it is the ease of money and the seemingly inexhaustible demand for good securities. The French loan for $100,000,000 was several times oversubscribed as have been a number of less important issues.

The Federal Reserve statement shows no changes of importance and interest rates have not risen, but Government bonds are again slightly lower and there are some bankers who frankly admit that they are getting rid of their securities against the time when the foreign balances held in this country will be withdrawn and money will become suddenly tight. If and when that happens, or soon after, the effervesence of the stock market will be at an end and it will be easier to judge of business conditions on their intrinsic merits.

Meantime, those who are prudent should be ready to shorten sail and heave to just as soon as the barometer commences to fall.

### Diefendorf Buys Meachem

The Diefendorf Gear Corp. has purchased the patterns, good will and some machinery of the Meachem Gear Corp., Syracuse, N. Y. The Meachem corporation announced its retirement from business recently. The Diefendorf corporation will move patterns and machinery to its new plant at 920 West Belden Ave.

# The Industrial Review

## *Progress of the machinery and machine-tool business in various parts of the country*

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

### Chicago

The general tone of the Chicago machinery market indicates a satisfactory outlook. While the demand for machine tools at this time is by no means brisk, there is a general feeling in the trade that, from now on, business will improve. No especial activity is looked for, however, until after the first of the new year. Inquiries are developing whose nature predicates a decided trend toward greatly increased activity in all machinery lines, for the next two years, at least. One of the reasons for this feeling of optimism is found in the railroad situation. A number of roads have let it be known that they will shortly be in the market for shop machinery on a large scale, material increases in rolling stock, as well as extensive repair work.

The automobile and truck industry also is regarded as affording a prospect for a not inconsiderable demand for machine tools and special machinery, all signs pointing to an increased production of vehicles during the year 1925. The intense activity in the radio field of manufacture, and the number of new concerns engaging in it, hold out possibilities for new and special machinery which, it is believed, will materialize in the form of orders within a short time. As compared with November, 1923, business in the Chicago machinery industry shows a slight improvement this month. It is not expected that December will develop any especial activity in the local market, and none is looked for until after the first of the year.

### New England

One of the heaviest machinery equipment contracts coming from the automotive industrial field of the West since the war is about to be placed with a Connecticut corporation. The head of this corporation has admitted that his company is awaiting the receipt of the signed contract. The contract figured on may be awarded piecemeal and the forthcoming authorized statement may not disclose the actual volume of the total.

Reflecting somewhat the condition prevailing in the stock market, business in the machinery industry disclosed greater activity during the last week. The improved condition was apparent in the business placed, and more so in the number of inquiries. Many of the inquiries have indicated anxiety for quick deliveries in the event of the placing of orders. This was particularly true in regard to the automotive trade inquiries. From different parts of New England statements were obtained indicating that railroad shop equipment business in fairly heavy volume has been placed. The buying was principally by Western roads. Future business indications, judged by preliminary correspondence, is most promising.

Machinery salesmen working out of this territory, report a much more cheerful sentiment among manufacturers visited and all report assurances of good business to be placed after Jan. 1. Dealers state that the orders received in the past two weeks have exceeded the volume of any two weeks in eighteen months previous. Planers and lathes are in somewhat better demand.

Special machinery builders report prospective business is excellent and the sentiment throughout this section is more cheerful.

### Milwaukee

Relief from stagnation which existed in many departments of the machine tool business at the opening of November has been experienced throughout the month. December opened with a better feeling than perhaps at the beginning of any month this year, for the local trade is fortified with a number of substantial inquiries that loom rather large in comparison with the quiet nature of requests for estimates in recent months.

The volume of sales of metalworking equipment in November, while by no means large or distinctive, nevertheless indicated an increase over October, but it did not quite reach the figure of the same month in 1923. On the other hand, demand already was experiencing a letdown a year before. The low point was reached during last August and there was no perceptible rise in the curve until early in November. The rise has been well sustained so far and gives every promise to continue its upward movement.

The production of milling machines, which forms a principal line in this market, has advanced slightly. The tenor of business remains without change of pitch, however. Makers are constantly being requested to figure on special types of multi-purpose tools, but the standard designs have but a scattering call. The automobile industry is the most active factor, but at best its requirements appear to be rather limited as to standard types.

Railroad business is of a strictly piecemeal character, and while it covers a much broader scope than inquiry traceable to any other distinct line, it has no aspect of freedom. Only the most necessary replacements are being made by shops in this territory, and practically the same holds true in most other districts.

The electrical industry, from the largest makers of hydroelectric generating units to manufacturers of radio parts, is experiencing an active season, which is more or less of a continuation of the condition of its trade for the past year. As in most other lines, users of tools are proceeding cautiously and making extensions of capacity only when close occupancy of the extended facilities are fairly well guaranteed in some degree of permanency.

### Indianapolis

While there is no present indication that this winter will see any phenominal business, the fact that the machinery and machine tool business is expanding is incontrovertable in the Indianapolis territory. From all sources come the report of "business picking up a little." Where the reports are so uniform it must mean that the future is a little brighter. Not only here in Indianapolis, but in the smaller industrial towns throughout the state the situation appears to be the same.

For the first time since early fall the automobile business appears better. The last week has seen some business in tools from this source and trade with the accessory manufacturers is better than it was. One of the largest automobile plants here is working to capacity and reports more business than in months. The company manufactures a high priced car and has just placed a new model on the market, which appears to be taking well and has necessitated some changes in machinery in the plant.

The fabricating plants here are doing a fair business and are making some purchases. In fact their business has held up remarkably well considering the lateness of the season and the fact that generally business falls so close to the first of the year. Their trade has slumped somewhat, but the decline has not been nearly so great as it is generally.

Machinery manufacturers, particularly in some lines, report business good. Demand for lumber working and flour milling machinery shows an increase since the election, as does the demand for brick machines, glass blowing machines, others of like nature.

### Canada

Unmistakable signs of improvement in the metal-working industry of Canada continue to make their appearance. In the steel industry particularly forward orders are being placed. Some manufacturers using steel products are insistent on early delivery. There is a varied assortment of semi-finished steel represented in the early tonnage records. Buying is diversified, which goes to show that ordering is of a general character.

The trend of industry generally is toward an accelerated rate of produc-

tion. Evidence of this is found in reports from Sault Ste. Marie, Ontario, where a considerable number of men have been taken on at the steel plant in the last couple of weeks; and from Galt, Ontario, where announcement is made that Hart Wheels of Hamilton, is preparing to open a plant, and a new industry—Galt British Forges—is erecting and equipping a plant for the manufacture of heavy and light forgings for marine, locomotive, steam shovel, bridge and other heavy works. The British Empire Steel Corp. reports the receipt of a large order for nails from western Canada.

Pulp and paper-making machinery, hydro-electric and general power plant equipment, and machinery incidental to the construction industry are in reasonably good demand. The machine tool industry, however, is slack. The ingot non-ferrous metals show a slight easing off following the announcement of election results in Great Britain and the United States. Fairly active buying of foundry and malleable iron is reported in the Toronto district.

The building situation offers one of the most hopeful indications of the upward trend. October's permit figures in eastern Canada alone exceeded those of last October by about $2,000,000. Among recent orders for equipment was one placed by Price Bros. of Quebec, with the Waterous Engine Co., for 14 pulp-grinding machines of new design, for the manufacture of which the Waterous company has just secured manufacturing rights in Canada.

## Buffalo

There continues to be much evidence that the machinery business will be considerably better in the near future, but as yet the actual condition remains practically unchanged compared with the business of the months preceding election. Generally speaking, most of the dealers are doing about as well as in October and their business compares favorably with the business of November, 1923. But some report a smaller business on either comparison, while one or two have had small increases.

Business is running about as it has for some months past, small individual orders for lathes, grinders, drill presses and an occasional milling machine order. There are no lists of any consequence out. However, there is a hangover accumulation of small individual inquiries that have been out some time and the time is approaching when many of these must be closed, which indicates better buying for December, regardless of large deals.

## New York

Buying of single tools was recorded in the New York district this week and further reports of inquiries were received. Inquiries have been coming in to all dealers in exceptionally good volume since the first week in November and sales have been fairly good as well. Dealers are not complaining about business, but were a trifle disappointed that improvement was not as great as anticipated.

The buyers this week have been mostly general industrials with small orders received by radio set builders. Some textile fabricators in New England have purchased textile machinery during the past week and further orders are epxected from this source after Jan. 1. Automobile factories in the East are busier this month than they have been and it is not expected that there will be any shutdown during December for inventory.

Used tools did not find as good a market this week as last and some complaint was heard from this section. However, not much business is expected by used tool dealers in December in the New York district.

## Detroit

Announcements of additions and extensions of plants in Detroit and of new models on the part of many of the automobile companies, together with a growing tendency to consolidate on the part of a large number of firms allied with the production of automotive equipments are having their influence upon the machine tool dealers in the city, and a more optimistic tone pervades their expressions than for some time past.

Of chief interest during the past week was the announcement of the formation of the Murray Body Corp., with a capitalization of $12,300,000. The merger includes the C. R. Wilson Body Co., J. C. Widman & Co., The Towson Body Co., and the J. W. Murray Manufacturing Co. The new corporation is the second largest independent auto body producer in the world.

A noticeable tendency of the larger manufacturers to feel more ready to place orders for new equipment and for replacements is evidenced by assertions of machinery men.

Motor Row expects an output during 1925 of close to 4,750,000 cars. Practically every manufacturer is getting ready to get his share of this production and subsequent sales.

# Business Items

The Gibb Instrument Co., Bay City, Mich., has changed its name to the Gibb Welding Machines Co. The change is in name only and not in personnel, and was made to better describe the company and its products.

The Terre Haute Grinding & Machine Co., Terre Haute, Ind., has moved into new headquarters at Tenth and Poplar Sts.

The Automatic Gear Blank Co., Indianapolis, has changed its name to the Central Gear & Manufacturing Co.

The Link-Belt Co., Chicago, has erected a new warehouse and office building at 5938 Linsdale Ave., Detroit, Mich.

The Milburn Sales Co., Philadelphia, has become the representative in the New York district for the Alexander Milburn Co., Baltimore, Md. The headquarters are at 309-311 Fifth Ave.

The New England Steel Ball Corp., Danbury, Conn., has filed a preliminary certificate of incorporation to engage in the manufacture of steel and metal balls and roller bearings of various kinds.

# Obituaries

ALBERT S. DAVIS, aged 77 years, died recently at a hospital in Geneva, N. Y. Mr. Davis was formerly the sole proprietor of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y. He was well known in the machine tool industry and was president of the Seneca Falls company until his retirement in 1917. Business houses in Seneca Falls were closed for an hour on the afternoon of the funeral.

ERNEST JEROME WINTER died recently at his home in Stamford, Conn. Mr. Winter was one of the engineers who designed the Niagara Falls Power House and was at one time chief engineer for the American Cyanamid Co.

# Personals

J. R. LAWRENCE, formerly with the Motch & Merryweather Machinery Co., Cleveland, has joined the sales department of the Marshall & Huschart Machinery Co., Chicago.

C. B. DEVLIEG, for a number of years works manager with the Kearney & Trecker Corp., Milwaukee, is now with the Rockford Milling Machine Co., Rockford, Ill.

DAVID S. WEGG, of Chicago, has been appointed assistant chief of the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce.

MARCUS A. GROSSMAN is affiliated with the United Alloy Steel Corp., Canton, Ohio, in charge of the research division.

J. N. LEGGETT has left the employ of the Curtis Aeroplane & Motor Co., Inc., Buffalo, N. Y., and is now with the Pittcairn Aviation at the flying field near Bryn Athyn, Pa.

CHARLES ANDERSON, secretary-treasurer and general manager of the Belle City Malleable Iron Co., Racine, Wis., has been elected president of the Racine Association of Commerce.

CHARLES KACHEL, for fourteen years superintendent of the Bossert Corp., Utica, N. Y., has retired from the sheet metal stamping business and will make his home in Miami, Fla. He expects to organize a sales organization in that city.

FRED G. KENT has been appointed vice-president of the Sowers Manufacturing Co., Buffalo.

S. ROMAYNE SOMERS has resigned as the secretary and the treasurer of the Westcott Valve Manufacturing Co., Seneca Falls, N. Y., and will move to California.

ELIJAH G. POXSON, former sales manager of the Dort Motor Car Co. of Flint, Mich., and later with the Flint Motor Co., has been made sales supervisor of the commercial vehicle department of the Reo Motor Car Co.

GEORGE H. JOHNSTON of the Gisholt Machine Co., Madison, Wis., is in Paris.

RICHMOND VIALL was elected assistant secretary of the Brown & Sharpe Manufacturing Co., Providence, R. I., instead of Richard Viall as erroneously reported in a recent issue of the *American Machinist*.

## Pamphlets Received

**Vocational Education in Geneva, Switzerland.** By Elise Hatt. Published by the Department of the Interior, Bureau of Education, Washington, D. C. This twenty-four page booklet is an interesting history and current story of the vocational educational plans now being pursued in Geneva. The trade school is a large institution in this city of only 160,000 population, and such arts as decorative painting, jewelry making, stone sculptoring, mechanics and electrotechnique arts, applied mechanics, embroidery, agricultural, clock making, and other trades of Switzerland are taught.

**Sickness Among 21,000 Automobile Workers.** By Dean K. Brundage, assistant statistician, United States Public Health Service. Published by the Treasury Department, United States Public Health Service, Washington, D. C. The plants at Flint and Pontiac have been reviewed from a standpoint of morbidity based upon the statistics of the Industrial Mutual Association of Flint, and the Pontiac Employees Mutual Benefit Association. The booklet is illuminating from an industrial standpoint and contains some interesting charts and tables of time lost by sickness and by specified diseases.

**Wages and Hours of Labor in Foundries and Machine Shops.** The U. S. Department of Labor, Washington, D. C. The wages paid during 1923 in the various states of the Union and the hours worked by the laborers and others employed in foundries and machine shops are contained in this one hundred and twenty page booklet recently issued. All workers are classified according to the kind of labor they perform and the rate paid to each classification is tabulated. The figures show that toolmakers earning $34.93 on an average throughout the United States receive the most money, and common labor receiving an average of $21.32 are the poorest paid with the exception of women workers of which there are very few.

**Safety Code for the Protection of Industrial Workers in Foundries.** Sponsored by the National Founders' Association, the American Foundrymen's Association and published by the Department of Labor, Washington, D. C. This is the tentative code of the American Engineering Standards Committee and touches on such subjects as plant layout, machines and equipment, lighting, heating and ventilation, operating rules, and safety and welfare.

**Proceedings of the Second Annual Conference of Indiana Foundrymen.** Published by the Engineering Extension Service, Lafayette, Ind. This conference was held at Purdue University under the direction of the Department of Practical Mechanics and the Indiana Foundrymen's Association and was a two day meeting. Papers were read by R. E. Wendt, G. F. Buxton, E. J. Lowry, William Woodhall, G. W. Gilderman, E. G. Jarvis, and others.

**Eye Hazards in Industrial Occupations.** By Louis Resnick and Lewis H. Carris. Published by the National Committee for the Prevention of Blindness, Inc., 130 East 22nd St., New York City. This two hundred and thirty-three page booklet is a most comprehensive study of eye hazards in various industrial plants in the United States and the preventions urged as well as the treatments given for injuries. Illustrations show the masks, eye goggles, and other equipment for workmen, and the guards used on machines.

**The Organization and Functions of the Institute of Research of Lehigh University.** Published by Lehigh University, Bethlehem, Pa. Circular No. 1 tells of the work and prospects of the Institute of Research at Lehigh University.

**Correcting Horsepower Measurements to a Standard Temperature.** By Stanwood W. Sparrow. Published by the National Advisory Committee for Aeronautics, Washington, D. C. The Government Printing Office, Washington, D. C. This is report No. 190 with many charts and diagrams.

## Trade Catalogs

**Firebrick.** The Societa Anonima G. Verrocchi, Milan, Italy, and Newcastle-on-Tyne, Eng. A most unusual catalog has been issued by this company. It is composed almost wholly of pictures, each one a drawing in colors in which the fire-resisting powers and the mechanical usages of the product are emphasized. The cover is a drawing in the form of an etching and is very effective. Although the captions and most of the reading matter is written in Italian, the illustrations are all that is necessary to tell the story.

**Upset Forgings.** The American Forge Co., 2621-2651 S. Hoyne St., Chicago, Ill. The first catalog of this comparatively new organization is exceptional and complete in every way. It contains easily readable text, together with many illustrations in which the products of the company are shown in process of manufacture and completed. Interior views of the factory show the capacity of the company and diagrams show the details of the products.

**Radial Drills.** The Western Machine Tool Works, Holland, Mich. Catalog No. 25 describes the low-hung drive, plain and universal radial drills. Blue prints are reproduced and dimensions are given in many cases. The many advantages of the company's products are set forth in excellent style.

**Steel and Iron.** Horace T. Potts & Co., East Erie Ave. and D St., Philadelphia, Pa. The stock list of the company has recently been issued. The products dealt in and the full descriptions are given with a thumb index on the right hand side, making it an easy reference book.

**Electric Melting Pot.** Harold E. Trent, 1524 Chestnut St., Philadelphia, Pa. Mr. Trent has mailed out a leaflet describing his new product, the Trent electric melting pot for continuous service.

**Self-Start Motors.** The Triumph Electric Co., Cincinnati, Ohio. This constant speed, polyphase, alternating current motor is built in complete range of sizes from three to 125 hp. with a high starting torque, high-power factor at start and low current consumption. The folder issued shows the motor assembled and parts of it as well as diagrams.

**Bearings.** The Chandler Machine Co., Ayer, Mass. The roller bearings made by this company for use in power plants are described in the catalog recently issued. Illustrations of the product, tables of friction and dimensions are given as well as diagrams and sectional drawings.

**Electric Furnaces.** The Detroit Electric Furnace Co., 2231 First National Bank Building, Detroit, Mich. The virtues of electric furnaces are set forth in a booklet recently mailed out by this company. The booklet claims that better control, a perfect casting, less losses, speed of production, the elimination of highly paid melters, no fuel or ashes, and other advantages result from the use of the Detroit furnace.

**Shaping Saw.** The Peerless Machine Co., Racine, Wis. The Peerless high-speed shaping saw is described in this four-page folder. Illustrations show the kind of work that can be done on the machine which otherwise would take the combined work of a cut-off machine, shaper, milling machine, keyseating machine, filing machine, and slotting machine.

**Shapers.** The Cincinnati Shaper Co., Cincinnati, Ohio. The Cincinnati Climax shapers are described and illustrated in a new catalog issued recently by the company. Parts of the machine are fully described and illustrated as well as the assembled product. Dimensions and specifications are given in a table and the design of the machine is also shown in drawings.

**Lapping Machinery.** The Bethel-Player Co., Westboro, Mass. Measuring machines and gages are described in this folder. The general purpose measuring machine made by this company and some of the smaller attachments are shown.

**Speed Reducers.** The Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill. Catalog No. 25 describes and illustrates the various types of "IXL" speed reducers made by this firm. Cross-section views are given, showing the details of construction of the different types and sizes, with instructions as to adaptations. The "IXL" couplings, bed plates for speed reducers, Ajax couplings and Francke and Grundy flexible couplings are also described and illustrated and views of "IXL" speed reducers in operation in various industries are included. There are several pages of parts illustrations for convenience in ordering for repairs, together with tables speed reducer sizes, ratios and prices.

**Expansion Boring Tools and Reamers.** The Davis Boring Tool Co., 3730 Forest Park Blvd., St. Louis, Mo. Catalog No. 24 describes and illustrates the patent micrometer-adjustment boring tools, expanding blocks and expansion reamers made by this company and shows, with the aid of a large number of drawings, how the tools can be applied to advantage on different classes of work. The Davis universal cutter-grinding attachment is also described and illustrated. The book includes a number of views of factory and office departments, together with a condensed description of the development of the tools and present manufacturing methods.

**Lubricating Devices and Oil Cups.** The Gits Bros. Manufacturing Co., 1940 Kilbourne Ave., Chicago, Ill. Catalog No. 20 contains illustrations and descriptions of the various types of oil cups, gravity and capillary attraction feed oilers, wick oilers and oil-hole covers manufactured by this firm. Cross-section views of the different kinds of oilers are shown and tables of dimensions are included, together with price lists.

## Export Opportunities

**The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.**

General and woodworking tools. Duisburg, Germany. Purchase and agency. Reference No. 12,402.

Small tools. Amritsar, India. Purchase and agency. Reference No. 12,351.

Small portable elevator or conveyor for loading stone and sand on wagons. Cairo, Egypt. Purchase. Reference No. 12,345.

Oil engines and lathes. Amritsar, India. Purchase and agency. Reference No. 12,351.

First class grinding machinery. Cechy, Czechoslovakia. Agency. Reference No. 12,346.

Machine tools. Dunfermline, Scotland. Purchase or agency. Reference No. 12,338.

Machine tools, wood and metal working. Prague, Czechoslovakia. Purchase. Reference No. 12,339.

## Forthcoming Meetings

**American Society of Mechanical Engineers.** Forty-fifth annual meeting. New York City, Dec. 1 to 4. Calvin Rice, secretary, 29 West 39th St., New York City.

**National Exposition of Power and Mechanical Engineering.** Grand Central Palace, New York City, Dec. 1 to 4. Charles F. Roth, 1102 Grand Central Palace Building, New York City.

**Exposition of Invention.** Engineering Societies Building, 29 West 39th St., New York City. Dec. 8 to 13 inc., General offices, 47 West 34th St., New York City.

**American Association for the Advancement of Science.** Meeting at Washington, D. C., Dec. 29, Jan. 1, 2 and 3. Burton Livingston, Smithsonian Institute, Washington, D. C.

**American Society for Steel Treating.** Winter Sectional Meeting under the auspices of the Cincinnati chapter. Thursday and Friday, Jan. 15 and 16, in Cincinnati.

**Society of Automotive Engineers.** Annual Meeting. Detroit, Mich., Jan. 20, 21, 22 and 23. C. F. Clarkson, 29 W. 39th St., New York City.

**American Society for Testing Materials.** Twenty-eighth annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., June 22, 23, 24, 25 and 26. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

**The Society of Industrial Engineers.** National Convention. Hotel Winton, Cleveland, Ohio, May 6, 7 and 8. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

# The Weekly Price Guide

## *Rise and Fall of the Market*

**Iron and Steel**—Pig-iron prices tending upward; No. 2 f'dry, Southern, advanced 50c. per ton during week; buying movement continues. Steel scrap up $1 per ton since Nov. 6. Mill price of terne plate higher. Unusually active demand for structurals at mills. Present prices are: bars, $2.10; shapes, $1.85@$2.10; and plates, $1.80@$2 per 100 lb., f.o.b. Pittsburgh. Minimum quotations on the principal hot-rolled products are 5 to 10c. per 100 lb. above the levels of Nov. 21.

**Non-Ferrous Metals**—Copper and tin are holding firmly at present levels. Lead market trifle easier. Upward trend continues in zinc sheets, solder and fabricated brass and copper products.

**Linseed Oil**—Raw oil now $1.11 per gal. (5 bbl. lots) f.o.b., New York, against $1.14, one week ago.

(All prices as of Nov. 29)

## IRON AND STEEL

**PIG IRON**—Per gross ton, f.o.b.:

| | |
|---|---|
| CINCINNATI | |
| No. 2 Southern | $22.55 |
| Northern Basic | 21.77 |
| Southern Ohio No. 2 | 22.27 |
| NEW YORK—Tidewater Delivery | |
| Southern No. 2 (silicon 2.25@2.75) | 25.10 |
| BIRMINGHAM | |
| No. 2 Foundry | 19.50 |
| PHILADELPHIA | |
| Eastern Pa., No. 2x (silicon 2.25@2.75) | 22.50 |
| Virginia No. 2 | 29.75 |
| Basic | 21.75 |
| Grey Forge | 21.75 |
| CHICAGO | |
| No. 2 Foundry local | 20.50 |
| No. 2 Foundry, Southern (silicon 2.25@2.75) | 25.00 |
| PITTSBURGH, including freight charge from Valley | |
| No. 2 Foundry | 22.77 |
| Basic | 22.77 |
| Bessemer | 23.77 |

**IRON MACHINERY CASTINGS**—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

| | |
|---|---|
| Detroit | 4.75 |
| Cleveland | 4.75@5.00 |
| Cincinnati | 5.00@7.50 |
| New York | 5.00@5.50 |
| Chicago | 5.25@5.75 |

**SHEETS**—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

| Blue Annealed | Pittsburgh Mill Base | New York | Cleveland | Chicago |
|---|---|---|---|---|
| No. 10 | 2.60@2.70 | 3.89 | 3.45 | 3.80 |
| No. 12 | 2.70@2.80 | 3.94 | 3.50 | 3.95 |
| No. 14 | 2.80@2.90 | 3.99 | 3.55 | 4.00 |
| No. 16 | 3.00@3.10 | 4.09 | 3.65 | 4.10 |
| Black | | | | |
| Nos. 17 and 21 | 3.25@3.35 | 4.40 | 4.15 | 4.55 |
| Nos. 22 and 24 | 3.30@3.40 | 4.45 | 4.20 | 4.55 |
| Nos. 25 and 26 | 3.35@3.45 | 4.50 | 4.25 | 4.60 |
| No. 28 | 3.40@3.50 | 4.60 | 4.35 | 4.50 |
| Galvanized | | | | |
| Nos. 10 and 11 | 3.50@3.60 | 4.60 | .... | 4.60 |
| Nos. 12 and 14 | 3.60@3.70 | 4.70 | .... | 4.70 |
| Nos. 17 and 21 | 3.90@4.00 | 5.00 | .... | 5.00 |
| Nos. 22 and 24 | 4.05@4.15 | 5.15 | 3.00 | 5.15 |
| No. 26 | 4.20@4.30 | 5.30 | 4.15 | 5.30 |
| No. 28 | 4.50@4.60 | 5.60 | 5.45 | 5.50 |

**WROUGHT PIPE (Welded)**—Warehouse discounts are as follows:

| | New York Black | New York Galv. | Cleveland Black | Cleveland Galv. | Chicago Black | Chicago Galv. |
|---|---|---|---|---|---|---|
| 1 to 3 in. steel butt welded | 48% | 34% | 55½% | 43½% | 56% | 43% |
| 2½ to 6 in. steel lap welded | 44% | 30% | 53½% | 40½% | 53% | 40% |

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

| Size, Inches | List Price per Foot | Diameters Inches External | Diameters Inches Internal | Thickness Inches |
|---|---|---|---|---|
| 1 | $0.17 | 1.315 | 1.049 | .133 |
| 1¼ | .23 | 1.66 | 1.38 | .14 |
| 1½ | .27½ | 1.9 | 1.61 | .145 |
| 2 | .37 | 2.375 | 2.067 | .154 |
| 2½ | .58½ | 2.875 | 2.469 | .203 |
| 3 | .76½ | 3.5 | 3.068 | .216 |
| 3½ | .92 | 4.0 | 3.548 | .226 |
| 4 | 1.09 | 4.5 | 4.026 | .237 |
| 4½ | 1.27 | 5.0 | 4.506 | .247 |
| 5 | 1.48 | 5.563 | 5.047 | .258 |
| 6 | 1.92 | 6.625 | 6.065 | .28 |

**SEAMLESS STEEL TUBING**—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ¼-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

| O.D. Inches | List Price per ft. | Differential Discount | O.D. Inches | List Price per ft. | Differential Discount |
|---|---|---|---|---|---|
| ¼ | $0.09 | 50% | ⅞ | $0.16 | 35% |
| ⅜ | .11 | 45% | 1 | .18 | 31% |
| ½ | .14 | 40% | | | |

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

**MISCELLANEOUS**—Warehouse prices in cents per pound in 100-lb. lots:

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Open hearth spring steel (base) | 4.50 | 6.00 | 4.20 |
| Spring steel (light) (base) | 7.00 | 6.00 | 6.00 |
| Coppered Bessemer rods (base) | 6.85 | 8.00 | 6.55 |
| Hoop steel | 4.49 | 4.35 | 4.15 |
| Cold rolled strip steel | 7.00 | 8.25 | 7.15 |
| Floor plates | 5.55 | 4.60 | 5.50 |
| Cold drawn shafting or screw | 4.05 | 3.90 | 3.80 |
| Cold drawn flats, squares | 4.55 | 4.40 | 4.30 |
| Structural shapes (base) | 3.34 | 3.20 | 3.10 |
| Soft steel bars (base) | 3.24 | 3.10 | 3.00 |
| Soft steel bar shapes (base) | 3.24 | 3.11 | 3.00 |
| Soft steel bands (base) | 3.99 | 3.20 | 3.65 |
| Tank plates (base) | 3.34 | 3.42½ | 3.10 |
| Bar iron (2.90@3.00 at mill) | 3.24 | 3.21 | 3.00 |
| Tool steel | 11.00 | .... | .... |
| Drill rod (from list) | 60% | 55% | 50% |

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.75c.; 5/32 to 1/4, 7.25c. per lb.

## METALS

Current Prices in Cents Per Pound

| | | | |
|---|---|---|---|
| Copper, electrolytic (up to carlots), New York | | | 14.50 |
| Tin, 5-ton lots, New York | | | 55.50 |
| Lead (up to carlots), St. Louis | 8.40@8.75 | New York | 9.37½ |
| Zinc (up to carlots), St. Louis | 6.90@6.95 | New York | 7.37½ |

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Antimony (Chinese), ton spot | 15.50 | 16.00 | ..... |
| Copper sheets, base | 21.37½ | 20.87½@21.37½ | 23.00 |
| Copper wire, base | 19.37½ | 19.75 | 21.75 |
| Copper bars, base | 20.62½ | 21.62½ | 22.50 |
| Copper tubing, base | 23.75 | 24.50 | 25.75 |
| Brass sheets, base | 18.12½ | 18.25 | 19.75 |
| Brass tubing, base | 22.50 | 23.75 | 28.25 |
| Brass rods, base | 16.12½ | 17.37½ | 17.50 |
| Brass wire, base | 18.62½ | 19.25 | 20.25 |

# Shop Materials and Supplies

## METALS—Continued

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Aluminium ingots, 98 to 99%, 1–15 ton lots | 27.20 | 28.00 | 28.50 |
| Zinc sheets (casks) | 11.50 | 12.00 | ..... |
| Solder (½ and ½), (case lots) | 40@41 | 34.00 | 30.00 |
| Babbitt metal (83% tin) | 60.00 | 64.50 | 48@52 |
| Babbitt metal (35% tin) | 28.00 | 19.50 | 23@26 |
| Nickel (ingots) f.o.b. refinery | 29.00 | ..... | ..... |
| Nickel (electrolytic) f.o.b. refinery | 33.00 | ..... | ..... |
| Nickel (F shot) f.o.b. refinery | 30.00 | ..... | ..... |

**SPECIAL NICKEL AND ALLOYS**—Price in cents per lb., f.o.b. Huntington, W. Va.:

| | |
|---|---|
| Rolled nickel sheet (base) | 52.00 |
| Hot rolled rods, Grade "A" (base) | 50.00 |
| Cold drawn rods, Grade "A" (base) | 58.00 |
| Manganese nickel hot rolled rods "E"—low manganese (base) | 54.00 |
| Manganese nickel hot rolled rods "D"—high manganese (base) | 57.00 |

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

| | | | |
|---|---|---|---|
| Shot | 32.00 | Hot rolled rods (base) | 40.00 |
| Blocks | 32.00 | Cold drawn rods (base) | 48.00 |
| Ingots | 38.00 | Hot rolled sheets (base) | 42.00 |

**OLD METALS**—Dealers' purchasing prices in cents per pound:

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Crucible heavy copper | 11.50@11.75 | 10.75 | 11.00 |
| Copper, heavy, and wire | 11.25@11.50 | 10.50 | 10.50 |
| Copper, light, and bottoms | 10.00@10.25 | 9.75 | 9.50 |
| Heavy lead | 7.00@7.25 | 6.50 | 7.00 |
| Tea lead | 6.00@6.25 | 5.00 | 5.50 |
| Brass, heavy, yellow | 7.25@7.50 | 6.75 | 7.00 |
| Brass, heavy, red | 9.00@9.25 | 8.75 | 8.50 |
| Brass, light | 6.25@6.50 | 5.75 | 6.00 |
| No. 1 yellow rod turnings | 7.75@8.00 | 7.00 | 7.00 |
| Zinc | 4.00@4.25 | 3.75 | 3.50 |

**TIN PLATES**—American Charcoal—Bright—Per box.

| | | New York | Cleveland | Chicago |
|---|---|---|---|---|
| "AAA" Grade: | | | | |
| IC, | 20x28, 112 sheets | $23.50 | $22.85 | $21.00 |
| "A" Grade: | | | | |
| IC, | 20x28, 112 sheets | 19.00 | 18.80 | 17.00 |
| | Coke Plates—Primes, 20x28 in. | | | |
| 100-lb., | 112 sheets | 13.00 | 13.00 | 12.75 |
| | Terne Plates—Small lots, 8-lb. Coating | | | |
| IC, | 14x20 | 7.25 | 6.80@6.90 | 6.50@6.75 |

## MISCELLANEOUS

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Cotton waste, white, per lb. | $0.14@0.21 | $0.19 | $0.14 |
| Cotton waste, colored, per lb. | .09@.14½ | .18 | .10½ |
| Wiping cloths, 13½x13½, per lb | 11.00@11.25* | 36.00 per M | .16 |
| Wiping cloths, 13½x20½, per lb. | .... | 50.00 per M | .16 |
| Sal soda, per 100 lb. keg | 2.25 | 2.25 | 2.65 |
| Roll sulphur, per 100 lb. keg | 3.60 | 3.25 | 3.50 |
| Linseed oil, per gal., 5 bbl. lots | 1.11 | 1.15 | 1.05 |
| Lard cutting oil, 25% lard, per gal. | .55 | .50 | .32 |
| Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal. | .29 | .35 | .21 |
| Belting—Present discounts from list in fair quantities (½ doz. rolls). | | | |
| Leather—List price, 24c. per lin. ft. per inch of width for single ply. | | | |
| Medium grade | 40–2½% | 30–10% | 30–10% |
| Heavy grade | 30–5% | 30% | 20–5–2½% |
| Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft. | | | |
| First grade | 50% | 50–10% | 40–10% |
| Second grade | 50–10% | 60–5% | 60–5% |

*White, at washery.

## *Comparative Warehouse Prices*

| New York | Unit | Current Price | Four Weeks Ago | One Year Ago |
|---|---|---|---|---|
| Soft steel bars | per lb. | $0.0324 | $0.0324 | $0.0354 |
| Cold finished shafting | per lb. | .0405 | .0405 | .0465 |
| Brass rods | per lb | .1612½ | .1487½ | .155 |
| Solder (½ and ½) | per lb. | .40@.41 | .38@.39 | .325 |
| Cotton waste | per lb. | .14@.21 | .14@.21 | 10@13 |
| Washers, cast iron (½ in.) | per 100 lb. | 6.50 | 6.50 | 6.50 |
| Emery, disks, cloth, No. 1, 6 in. dia. | per 100 | 3.38 | 3.38 | 3.38 |
| Lard cutting oil | per gal. | .55 | .55 | .55 |
| Machine oil | per gal. | .29 | .29 | .297 |
| Belting, leather, medium | off list | 40–2½% | 40–2½% | 30–10% |
| Machine bolts up to 1x30 in. | off list | 45% | 45% | 45% |

## MISCELLANEOUS—Continued

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets: | | | |
| Flint paper | $4.86 | $5.84 | $6.48 |
| Emery paper | 10.71 | 11.00 | 8.80 |
| Emery cloth | 28.00 | 31.12 | 29.48 |
| Emery disks, 6 in. dia., No. 1 grade, per 100: | | | |
| Paper | 1.49 | 1.24 | 1.40 |
| Cloth | 3.38 | 2.67 | 3.20 |
| Fire clay, per 100 lb. bag | | .65 | .60 |
| Coke, prompt furnace, Connellsville | per net ton | | 3.25@3.50 |
| Coke, prompt foundry, Connellsville | per net ton | | 4.75@5.25 |
| White lead, dry or in oil | 100 lb. kegs | New York, 15.25 | |
| Red lead, dry | 100 lb. kegs | New York, 15.25 | |
| Red lead, in oil | 100 lb. kegs | New York, 16.75 | |

## SHOP SUPPLIES

| | New York | Cleveland | Chicago |
|---|---|---|---|
| Rivets: Button heads, ¾-in., ⅞-in., 1x2-in. to 5-in., per 100 lb. | $5.00 | $3.50 | $3.50 |
| Cone heads, ditto | 5.20 | 3.60 | 3.70 |
| Washers, cast iron: ½-in. per 100 lb. | 6.50 | 4.00 | 3.75 |
| ⅝-in., per 100 lb. | 5.50 | 4.00 | 3.75 |

Machine bolts, up to 1x30-in., with cold punched and hot-pressed hex. nuts, also button head bolts with hex. nuts are $3.50 per 100 lb. at Cleveland. Tap bolts with hex. heads are $4.65 per 100 lb. at Chicago.

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 45%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 35%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 40%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 35%.

Coach and lag screws, 1½x-⅛in., $2.25 per 100, less 45%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35%.

Bolt ends, 1x12-in., 10c. per lb., less 45%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for ⅛-in. and smaller and 65% for ¼-in. and larger.
Case hardened, ½x½-in., 6c. each, less 50%.

Rivets, ⅛x1-in. and longer, 19c. per lb., less 60%. Same discount for tinned. EXTRA per 100 lb. for 1⅛ to 2-in. long, all diameters, 25c.; ¼-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

# Machine Requirements and Industrial Construction

## Machine Tools and Equipment Wanted

**Ala., Eufaula**—Eufaula Mill & Lumber Co., J. H. Banks and P. B. Ross, owners—planning mill machinery.

**Calif., Los Angeles** — Weber Auto & Trailer Wks., 1505 Santa Fe Ave.—one Cincinnati milling machine No. 2-M (used).

**Ill., Sterling**—Charter Gas Engine Co.—lathes, planers, boring mills, etc., for light and heavy work, 5 ton crane.

**Mass., Boston**—Keystone Mfg. Co., 53 Wareham St., (metal toys)—equipment for new plant at 288 A St., South Boston.

**Mass., Boston**—H. H. Proctor, Rm. 50, 146 Summer St.—bench lathe for light work.

**Mass., Boston**—E. H. Tate Mop & Cordage Co., 67 Sudbury St.—machine for cutting and straightening wire from No. 10 to 16 gage.

**Mass., Boston**—Tower Mfg. Corp., 98 Brookline Ave. (radio appliances)—equipment for the manufacture of loud speakers.

**Mass., Brockton**—Brockton Public Market, Purchase St.—tools and equipment for garage and repair shop.

**Mass., Brockton** — A. D. Stebbins, 15 Seaver St.—mortiser and tenoner machines.

**Mass., Brookline**—S. Sriberg, 188 Rawdon Rd.—equipment and repair tools for service garage.

**Mass., Charlestown** (Boston P. O.)—McNutt Wrecking Co., Mystic Docks—portable saw.

**Mass., Dorchester,** (Boston P. O.)—Frost Coal Co., 478 Neponset Ave.—equipment for service garage.

**Mass., Lynn**—D. A. McKillip, 424 Broadway—woodworking lathe.

**Mass., Lynn**—Sprague, Breed, Stevens & Newhall, Central Sq.—tools and equipment for repair and service garage.

**Mass., Revere**—N. Sinatra, 65 Douglas St.—tools and equipment for automobile repair shop on Broadway.

**Mass., Roxbury** (Boston P. O.) — Bay State Welding Co., 1641 Columbus Ave.—additional equipment and tools for welding station.

**Mass., Roxbury** (Boston P. O.) — A. Gavieni, 59 Burrill St.—equipment and tools for general garage and automobile repair shop on Main St., Cambridge.

**Mass., Roxbury** (Boston P. O.)—E. Van Noorden Co., 100 Magazine St., (sheet metal workers)—miscellaneous machinery for enlargement of plant.

**Mass., South Boston** (Boston P. O.)—J. Coffey, 247-L St.—bench saw with or without motor.

**Mass., South Boston** (Boston P. O.)—J. Linn, 247-L St.—power table saw.

**Mass., Watertown**—C. J. Connelly, 81 Main St.—equipment for service garage.

**Mich., Bay City**—Lewis Mfg. Co., T. P. Dixon, Gen. Mgr.—equipment for planing mill, also for making interior woodwork finish.

**Mich., Detroit** — Carey & Esselstyn, 602 Hoffman Bldg., Engrs., are receiving bids for gasoline locomotive cranes on caterpillar treads for the Mississippi Glass Wks., 4070 North Main St., St. Louis, Mo.

**Mich., Detroit** — Dept. of Purchases & Supplies, 700 Marquette Bldg., F. M. Meyer, Comr.—1 quick change lathe with 4 jaw independent chuck.

**Mich., Ironwood** — B. A. Morgan, 120 North Suffolk St.—woodworking machinery including shaper.

**Mich., Pontiac**—Jewett Radio & Phonograph Co., 79 South Saginaw St.—miscellaneous equipment for radio cabinet making.

**Mo., Lamar**—Lamar Broom Works—complete line of broom manufacturing machinery (used).

**Mo., St. Louis** — Atlas Iron Works, Geraldine and Sievin Sts., A. H. Koppers, Secy.—electric crane, 50 to 65 ft. span, 7½ to 10 ton capacity, 3 phase, 60 cycle, 220 volt, A. C. current (used).

**N. J., Newark**—E. E. Steiner Co., No. 2 Ave. C.—one 8 ft. squaring shear.

**N. Y., Buffalo**—Plastergon Wallboard Co., Philadelphia Ave., W. Saville, Purch. Agt.—machinery and equipment for the manufacture of wallboard to replace that destroyed by fire.

**N. Y., Lackawanna** (Buffalo P. O.)—The Bd. of Educ.—tools including one 12 in. screw cutting lathe, 6 ft. bed, 1 drill press, 1 emery grinder, 1 blacksmith forge all equipped with driving power and necessary tools.

**O., Cleveland** — The Ohio Body Blower Co., 9205 Detroit Ave.—1 belt driven 6 ft. steel press brake.

**O., Columbus**—Madison Service & Sales Co., 188½ East Long St., R. F. Gatch, Engr. (auto accessories)—metal working equipment for new factory to be erected in 1925.

**O., Elyria**—General Phonograph Co.—6 presses and 6 smaller miscellaneous machines.

**O., Youngstown**—Commercial Shearing & Stamping Co., Box 309—toggle drawing press equivalent to Toledo 168½ or Bliss 13-A, tie rod construction required.

**Pa., Bradford**—Star Garage Co., Inc., James Bldg.—cylinder reboring machine, lathe, drill press and air compressor.

**Pa., Clearfield** — Gearhart Knitting Machine Co., E. W. Dame, Supt.—machinery for new plant.

**Pa., Johnstown**—National Radiator Co.—Newton No. 4 vertical milling machine.

**Pa., Philadelphia** — Pennsylvania R.R., Broad St. Sta., S. Porcher, Gen. Purch. Agt.—one Universal tool cutter grinder for Harrisburg, Pa.; one boring mill for Ft. Wayne, Ind.; one radial drill for Altoona, Pa.; one drill press for Columbus, Ohio.

**Pa., Pittsburgh** — Carnegie Steel Co., Frick Annex and Carnegie Bldgs.—lathes, radial drill, shaper, cold saw for Youngstown plant.

**Pa., Uniontown**—The W. J. Rainey Coal & Coke Co., Mt. Braddock, machine shop, including machinery and tools destroyed by fire, loss is estimated at $100,000. Decision as to rebuilding will not be reached for several weeks.

**Va., Franklin**—Camp Mfg. Co.—10 x 10 in. or 10 x 12 in. Clyde Universal skidder.

**Va., Wytheville**—R. P. Johnson—electric crane, ¾ yd. clam shell bucket with about 25 ft. boom, 60 cycle, 220 volt, A. C. current (used).

**Wash., Camas**—Camas Lumber Co., J. O. Storey, Pres.—complete line of machinery for saw and planing mill.

**Wis., Appleton**—Appleton Auto Exchange, 892 College Ave.—lathe and air compressor for garage.

**Wis., Baraboo** — B. J. Kramer (woodworking)—sticker.

**Wis., Marshfield**—R. Connor Lumber Co., Central Ave. (saw mill)—power gang saw, rip saws, band saw mill.

**Ont., Elmira**—The Elmira Planing Mill Co., Ltd., N. M. Bearinger, Mgr.—sash and door clamping machine (used).

**Ont., Galt**—Canadian Hart Wheels Co., Hamilton—equipment for $40,000 plant to be opened here.

**Ont., Galt** — Galt Forges Co., Beverly St., E. St. Clair, Mgr.—equipment for $50,000 plant for manufacture of special forgings.

**Ont., Galt**—P. W. Gardiner & Sons, (sash and door manufacturing)—machine shop equipment.

**Ont., London**—Richards Wilcox Canadian Co., W. R. Yendall, Mgr.—special new equipment and machinery for manufacture of hardware specialties.

**Ont., Port Arthur**—J. & W. J. Stirret, Bay St. — equipment, including planers, saws, motors, etc.

**Ont., Stratford**—The Stratford Mfg. Co., Ltd., C. A. Moore, Mgr. (woodenware, etc.)—mitre saw and double cut off saw.

**Ont., Toronto**—W. G. Price, 1521 Davenport Rd.—one 2 spindle borer which runs horizontal bores 1 in. to 6 in. or 1 in. to 3 in. apart. (used.)

**Que., Bic**—F. Plourde—molding machine, tenoner, mortiser, matcher and saws.

**Que., Gracefield** — G. Carr — equipment for garage and repair shop.

## Opportunities for Future Business

**Calif., Huntington Park**—Roberts-Cohen Furniture Mfg. Co., 925 West Irvington St., will build by day labor a 2 story, 50,000 sq. ft. addition to factory. L. A. Smith, 301 South Western Ave., Los Angeles, Archt.

**Calif., Los Angeles**—Auto Sheet Metal Works, 2004 South Main St., manufacturers of auto tops, bodies, auto sheet metal work, bumpers, hoods, tanks, etc., awarded the contract for the construction of a 1 story, 100 x 100 ft. shop on South Park Ave.

**Calif., Pomona**—National Vacant Seat Indicator Co., c/o Wesco Construction Co., Marsh-Strong Bldg., Los Angeles, awarded the contract for the construction of a 1 story factory. Cost $42,000.

**N. Y., Buffalo**—Bd. of Educ., 1400 Telephone Bldg., will receive bids until Dec. 15 for the construction of a 3 story electrical vocational school on East Delaware Ave., for F. A. Spangenberg, 250 Delaware Ave. Estimated cost $600,000.

**O., Cleveland**—The Carey Machine Co., V. P. DeHart, Pres., 5606 Curtiss Ave., awarded the contract for the construction of a 1 story, 90 x 120 ft. machine shop on Cassins Ave. Estimated cost $50,000.

**O., Cleveland**—Cleveland Twist Drill Co., J. D. Cox, Jr., Pres., East 49th St. and Lakeside Ave., awarded contract for a 1, 2 and 4 story, 38 x 71 ft., 38 x 64 ft., 18 x 24 ft., 18 x 38 ft. additions to factory. Estimated cost $50,000.

**O., Cleveland**—Klein Auto Body Co., B. Klein, Pres., 5707 Storer Ave., awarded the contract for the construction of a 1 story, 50 x 140 ft. factory on West 25th St. Estimated cost $40,000.

**Pa., Clearfield**—Gearhart Knitting Machine Co., E. W. Dame, Supt., awarded the contract for the construction of a 4 story, 32 x 82 ft. plant.

**Pa., Economy** — Central Tube Co., 1st National Bank, Pittsburgh, awarded the general contract for the construction of 3 one story, 115 x 225 ft., 100 x 450 ft., 75 x 200 ft. buildings.

**Vt., Fairhaven**—Vermont Milling Products Corp., plans to rebuild plant recently destroyed by fire. Estimated cost $500,000.

**Wis., Port Washington**—The Gilson Mfg. Co. (machinists and founders), awarded the contract for the construction of a 1 story, 60 x 120 ft. factory. Estimated cost $30,000.

**Ont., London** — Richards Wilcox Canadian Co., W. R. Yendall Mgr., manufacturers of hardware specialties, awarded the contract for extension to plant. Estimated cost $50,000.

**Ont., Port Arthur**—J. & W. J. Stirret, Bay St., will build by day labor a planing mill and lumber yard at Bay and Court Sts.